JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3, 1879.

VOL. XXXIV NO. 4 | SAN FRANCISCO, JANUARY 23, 1915 | PER COPY, 25 CENTS

THE BEST CONTROL OF PUBLIC UTILITIES.

INDUSTRIAL USES OF FUEL OIL.
BY F. B. DUNN.

INSIDE WIRING METHODS.
BY JOHN CARRELL.

INDUCTION INTERFERENCE DISCUSSION.

LIBRARY OF CONGRESS
JAN 27 1915
PERIODICAL DIVISION

MATERIALS ADVERTISED IN THIS ISSUE

Anchors
Hubbard & Co.

Batteries
Edison Storage Battery Supply Co.

Boiler Feed Water Treatment
Dearborn Chemical Co.

Diesel Engines
Busch-Sulzer Bros. Diesel Eng. Co.

Heating Appliances
Simplex Electric Heating Co.

Insulators
Hemingray Glass Co.
Pierson, Roeding & Co.

Motors
Century Electric Co.
Wagner Electric Co.

Piping
Pittsburg Piping & Equipment Co.

Pole Line Hardware
Hubbard & Co.

Power Plants
Chas. C. Moore & Co.

Pumps
Westinghouse Machine Co.

Transportation
Southern Pacific Co.

Turbines
Pelton Water Wheel Co.

Wire (Trolley)
"Phono," Pierson, Roeding & Co.

Wire and Cable
The Okonite Co.
Standard Underground Cable Co.
Pierson, Roeding & Co.
Pacific States Electric Co.

Alphabetical Index to Advertisers, Page 8 Where to Buy It in the West, Page 7

It's the insulation that preserves the line

Let your new work be lasting work

"O.K." WEATHERPROOF

the only *really weatherproof wire.*

The standard with the electrical world for over 20 years

Manufactured in triple braid exclusively, because years of experience in manufacturing insulated wire have demonstrated its superiority as a satisfaction giver.

The first and second braids are thoroughly saturated with dense pitch compound, and applied at high temperature, while the third absorbs any excess compound on the previous layers, and is coated with natural Austrian paraffin wax, ground into the meshes, which takes a permanent highly polished surface, and sheds rain and moisture.

Only manufacturers following such a two dip process

No hard coated surface to crack and peel or "drifting" of coating to bottom of wire, leaving top insulation exposed to early rot by heat and water. Rough and uneven surfaces which catch moisture, with consequent swelling and shrinking, split, frayed and tattered insulation, eliminated.

Our belief is so strong in the uniformity and strict compliance to weight schedules, finish and durability of

"O. K." WEATHERPROOF WIRE

we guarantee it to you for twenty years.

It will mean economy and efficiency for you to investigate.

PACIFIC STATES ELECTRIC CO.

The Modern Electrical Supply House

Distributors for the Pacific Coast

LOS ANGELES OAKLAND PORTLAND SAN FRANCISCO SEATTLE

Member Society for Electrical Development—"DO IT ELECTRICALLY"

JAN 26 1915 ©CLB328424

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXXIV SAN FRANCISCO, JANUARY 23, 1915 NUMBER 4

[COPYRIGHT 1915 BY TECHNICAL PUBLISHING COMPANY]

THE BEST CONTROL OF PUBLIC UTILITIES

BY FRANK G. BAUM.

(After a general discussion of the need for class rates for different classes of service, the author outlines methods for determining them. This article is slightly abridged from a paper presented before the San Francisco Section of the American Institute of Electrical Engineers, Jan. 22, 1915.—The Editor.)

It must be evident to anyone who has given serious consideration to the subject of the control of public utilities that it is necessary always to have in mind the following as an axiom:

The best control of a utility is that which develops an eagerness and ability on the part of the company to furnish the service, and an equal eagerness and ability on the part of the consumer to purchase the service.

Note that there must be both eagerness and ability on each side in order to promote the best interests of the business. Now how are we to determine the best way in which to develop this eagerness and ability on the part of the company and the consumer?

1. There must be developed a diversified use of electric energy.

2. Fair public service commissions must act as boards of arbitration between the company and the consumer.

3. The rate of return on the investment must be liberal.

4 (a). There must be confidence in the company and its rates, and class rates are absolutely necessary for the development of the business.

4 (b). Uniform class rates for a system or territory are advisable where one commission regulates the rates.

5. There must be some incentive for the company to make economies in construction and operation.

[The paper then gives an explanation of these five requisites. As the first three are self-evident to engineers they are omitted here, as is also a part of 4 (a) proving the equity of varying rates for different classes of service.]

Lake Almanor, Storage Reservoir for Great Western Power Co., a Typical Commission Regulated Utility in California.

The lighting consumer's rate is much higher than the rate to the power consumer because:

First—The investment and cost of operation to serve the lighting consumer are greater than the investment and cost of operation to serve the power consumer, and

Second—Much more important, the total energy consumed by the power consumers is much greater than that used by the lighting consumers for the same peak demand.

The confusion that exists in the case of the lighting rates comes from charging for the same unit of service. In railroad freight and passenger rates there is a natural difference in the method of charging, hence there is no confusion. In the lighting and power busi-

JOURNAL OF ELECTRICITY
POWER AND GAS

FOUNDED 1887

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Crossley Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBT. SIBLEY, Treas. and Special Contributor
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

ON LIBRARY CARS OF ALL SOUTHERN PACIFIC TRAINS

TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	" "	3.50
Other Foreign Countries within the Postal Union	" "	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS.

Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

CONTENTS

San Francisco's New Auditorium 41

Plans of National Joint Committee on Line Construction... 44

The Output of a Dry Cell 44

A Lighting Contract Clause 44

Inside Wiring Methods 45
By John Carrell

The Latent Heat of Ice 46

Melting Points 46

Industrial Uses of Fuel Oil 47
By F. B. Dunn.

Inductive Interference—Discussion 48

Editorials 50
Tube Wire.
The Coming of The Lumen.
Helping Ourselves by Helping Others.

Personals 52

Meeting Notices 52

News of California Railroad Commission 53

News of Washington Public Service Commission 53

Committees for 1915 Contractors' Convention 53

California Association of Electrical Inspectors 54

Trade Notes 54

News Notes 55

Tube Wire

Great interest exists in electrical circles as to what action the National Board of Fire Underwriters will take regarding the new concentric system of wiring, whose practical details were summarized in this journal last week. Before this economical method can be adapted from German to American practice it must be approved by the underwriters at their annual meeting in March.

Their favorable action would have a greater influence in increasing current consumption than is usually understood. Many small consumers are deterred from using electric current for lighting their homes because of its high cost. The initial cost of installation is particularly and necessarily high, and any factor which will reduce it will be of material aid in inducing the poorer man "to do it electrically."

Such a factor has been found in an insulated wire encased in a thin metal covering which acts not only as a protector but also as a return circuit in grounded systems. This wire was invented several years ago in Germany by a Mr. Kuhlo, whose name one manufacturer adopted to designate the wire. Other manufacturers called it "Rohrdadt," or tube wire, while in this country it is more generally known as concentric wire.

The wire is installed either by concealing it in the walls and ceiling or by fastening it onto their surface. The cost of the material is naturally much less than approved American equipment and the labor cost is also reduced, one wireman having set as much as 600 feet in a day. The ratio of the cost of labor to the cost of material, however, is greater than with the present systems.

While the immediate effect of its adoption would be to somewhat upset the supply and contracting business, conditions would soon adjust themselves as its uses and limitations are determined.

While it is impossible to prophesy the underwriters' decision their past action on similar questions would seem to indicate that it might be unfavorable. The board has always been suspicious of the fire hazard of any such system until it has been definitely proved to be safe. The burden of the proof rests upon the manufacturers. While the admitted increase in the number of fires of electrical origin is largely due to the correspondingly greater increase in the number of electrical installations, there yet remains abundant cause for safeguarding the use of electric current.

The American rules are much stricter than those of other countries. The factors of safety are larger and the specifications more severe. These requirements are to a large extent independent of the type of building construction, the wiring precautions in a Class A building being but little different from those in more inflammable types. This policy of safety first has been characteristic of the underwriters and a strong incentive will be necessary to cause them to reverse it in this case.

This statement does not mean that tube wiring is dangerous, for its safeness has been definitely proven in Germany. It merely means that higher standards for fire risk have been set in this country.

While they do not question the wisdom of caution, progressive electrical men are fully aware of the

opportunity to introduce electricity into the most humble home which this new method affords. That yesterday's luxury become today's necessity is only possible by bringing the price within the reach of all. To make electricity the cheapest, as well as the best, source of lighting, its cost must be reduced. If it were possible to approve this new form of wiring as a substitute for molding construction for 600 watt installations, no wires being concealed, the entire electric industry would be greatly stimulated.

The Coming of the Lumen

There is every present indication that the wattage rating of incandescent lamps will soon be as little used as the once popular candle power rating. Just as the twenty-five watt lamp has displaced the sixteen candle power lamp in the parlance of the day, so does the lumen bid fair to be the future standard rating.

The lumen is the unit of light flux, as distinguished from the candle power, which is the unit of light intensity—"the intensity which produces unit flux density at unit distance from the light source and thus produces a total flux of light equal to 4π units (the surface of the sphere at unit distance from the light source.") This means that instead of measuring the amount of light radiated in a certain specified direction, such as the mean horizontal candlepower, the total amount of radiation is measured and evaluated according to its capacity to produce the sensation of light.

The selection of a proper standard for light measurement has been difficult. Light is a physiological sensation produced by a physical radiation. To those who have no sight there is no light. But the human equation is so variable that a definite standard of sight is not possible and so arbitrary units of light measurement are now in general use.

The inadequacy of these empirical ratings has long been realized by scientific men, but the mere inertia of the older nomenclature has been sufficient to retain it long after it has outlived its usefulness. The force of progress, however, is strong enough to overcome the most inert conservative. Recent strides in means of efficient light production demand that methods of measurement catch up with the procession.

Careful investigation has shown that reliable photometric measurements of the new high-efficiency gas filled lamps can only be expressed in terms of lumens. In a recent paper before the Illuminating Engineering Society, Mr. Clayton H. Sharp has shown that the old photometric methods did not give constant results for the new type of lamp, there being a disturbing flicker and as much as 15 per cent variation in readings due to the rotation of the lamp while measuring its mean horizontal candlepower. As this difficulty can be obviated by measuring the total luminous output in terms of lumens, as is now the general practice in arc lamp photometry, it seems probable that the more scientific term will also be adopted as a standard for all electric lamps.

Such a change should cause but little confusion. On 110 volt circuits, 25 watt lamps would be known as 210 lumen lamps, and 40 watt as 336 lumen. The rating cited is based upon the present efficiency of the Mazda lamps specified. With higher efficiencies the lumen output is correspondingly increased.

The lumen has so much to recommend it as a rational unit of light measurement that its early adoption as a universal means for designating lamps is something greatly to be desired. If some such unit could have been used by the central stations in billing their lighting consumers much of the present misunderstanding about the necessary diffenence in rates for light and power might have been obviated. Many a man would be satisfied to pay one cent for 1200 lumen hours when he objects to paying seven cents per kilowatt hour, though the amount involved in each case is the same. Incidentally such a scheme might be of material assistance in turning the difficult corner which will arise when the new high efficiency lamps become available in smaller sizes for 110 volt circuits.

Separate meters are usually installed for lighting and power or heating circuits. If the lighting meter were graduated to read in lumen hours and the power meter in kilowatt hours the consumer would soon become accustomed to the change and the power company would be rid of one frequent cause for complaint.

While there is not much likelihood that this suggested plan will be applied, there is little doubt but what the lumen will be used for all lamp ratings in the near future. It consequently behooves every electrical man to become familiar with the term and be ready to explain it when it is applied.

Helping Ourselves by Helping Others

One advantage of slack business conditions is the chance afforded to finish some long-cherished plan. Opportunity is offered to perfect a design, to patent an idea or to write a paper which will materialize past thoughts. A thought has value as it is expressed and is lost if repressed. The more permanent the mode of expression the greater the value.

Every man has ideas which are worthy of lasting record. In the electrical industry they may be ideas for improving the design of apparatus or for increasing the efficiency of operation, they may be plans for increasing the use of current and of current-consuming devices, or they may be ideals for bringing about better relations between the public utility and the public served. All these thoughts are needed to improve the industry.

As a means for conserving these ideas and passing them on to greater uses the technical magazine freely offers its services. In this respect it belongs to its readers and the more freely its columns are used the more real becomes the ownership. This journal invites contributions from its readers and welcomes any expression of thought, whether in praise or condemnation.

The writer of a paper gains far more than he realizes. One of the surest ways of finding out how little you know about a subject is to write about it. Writing compels knowledge and teaches the writer for more than it teaches others. But above all. each of us owes a debt to all of us, past and present, for most of the knowledge we have, and the only way we can pay that debt is to contribute our findings to the common collection of experiences.

PERSONALS

F. C. Finkle, consulting engineer, has returned to Los Angeles from a brief trip to Northern California.

W. S. Heger Jr. of the San Francisco office of the Busch-Sulzer Bros. Diesel Engine Company, is in Arizona.

C. A. Hunt of the Hunt Electric Company, Santa Cruz, spent several days during the past week at San Francisco.

Hal Lauritzen, Pacific Coast manager for the Holophane Works of the General Electric Company, is at Los Angeles.

F. D. Fagan of the General Electric Company, San Francisco, arrived the first of the week from a business trip to Portland and Seattle.

H. C. McCutcheon, in charge of the Los Angeles office of R. D. Holabird Company, has returned home after a week's stay at San Francisco.

Geo. A. Gray, Pacific Coast representative at San Francisco of Crouse, Hinds Company, is making a business trip through Southern California.

G. I. Kinney of the General Electric Company, San Francisco, has been appointed manager of the company's entire exhibit at the Panama-Pacific International Exposition.

R. M. Alvord, manager of the supply department, General Electric Company, San Francisco, left during the week for an extended business trip through Southern California.

H. V. Carter, president Pacific States Electric Company, San Francisco, is spending some days in Los Angeles and San Diego, the seat of the Panama-California Exposition.

W. M. Hamilton, Salem (Oregon) manager for the Portland Railway, Light & Power Company, was recently made chairman of the board of governors of the Salem Commercial Club.

W. P. Naser has been appointed manager of the San Francisco branch of the Trumbull Electric Company of Plainsville, Conn. Mr. Naser's headquarters will be at 595 Mission street.

A. V. Olson, assistant manager Electric Railway and Manufacturers' Supply Company, San Francisco, returned during the week after a several days' trip to Fresno, Cal., and surrounding territory.

J. A. Vandegrift, manager of the Oakland Lamp Works of the General Electric Company, is at present making an extended business trip to Portland, Seattle, and through the Northwest generally.

A. B. Bond, formerly of the Mazda Bureau of the General Electric Company, San Francisco, has been placed in charge of that company's Mazda exhibit at the Panama-Pacific International Exposition.

C. B. Cooper, chief operator of the Marconi Wireless Telegraph Company, Seattle, has been appointed superintendent of radio services of the Kilbourne & Clark Manufacturing Company of Seattle.

C. E. Gilmer, after a legal battle lasting two years, has won back his position as superintendent of outside construction for the Seattle lighting department, the Supreme Court recently deciding in his favor.

Clyde B. Aitchison, Oregon Railway Commissioner, has returned to Salem from Baker, Ore., where he collected data bearing on the rate case of the Eastern Oregon Light & Power Company, and on the proposed municipal lighting plant.

T. C. Martin, executive secretary of the National Electric Light Association, and **Geo. Elliott,** master of transportation, are expected to arrive in San Francisco January 18th, to confer with the general convention's committee about the national convention to be held at San Francisco in June.

O. D. Street, assistant general sales manager of the various distributing houses of the Western Electric Company, with headquarters at New York City, is making a business trip through Pacific Coast territory. He is expected arrive in Los Angeles during the week, at which point **F. H. Leggett,** Pacific District manager of the company, will meet and accompany him north to San Francisco, en route to Portland and Seattle.

A. E. Beck has resigned as permanent counsel for the British Columbia Electric Railway Company at Vancouver to resume private practice of law. Mr. Beck had been with the company for seven years and was a prominent member of the Pacific Coast Claim Agents' Association. A cabinet of silver ware was presented to him by the officials of the company when he formally severed his connection on January 1.

E. W. Newcomb has been appointed representative of the primary battery department, Thos. A. Edison Company, San Francisco, succeeding **P. B. Hyde,** who left last week to assume the duties of his new position with the company at Orange, N. J. Mr. Newcomb was formerly with the signal department of the Southern Pacific Company at Oakland, Cal. More recently, however, he was construction foreman of signals on the Salt Lake division of the O. S. L. and left the position of signal engineer of that company to take up the new line.

MEETING NOTICES.

Los Angeles Section Electric Vehicle Association.

At the monthly meeting of the Los Angeles Section of the Electric Vehicle Association of America, W. F. Rath read a paper on "Exide Batteries in Electric Vehicles." The paper was discussed by R. H. Starrett, W. R. Guy, B. J. Martin and J. Harry Pieper. M. W. Harrison talked on the application of storage batteries to everything on wheels, provoking a lively and general discussion. Three new applications for associate membership were presented and S. L. Mitchell, secretary and general manager of the Automobile Club of Southern California, was elected an honorary member. J. O. Case, chairman of the garage committee, reported good results in an effort to have uniform rates for charging adopted by the garages. P. H. Ducker, superintendent of transportation for the Southern California Edison Company, read comparative tables of cost for operating four gas cars and four electric cars in his company's service, the electric cars proving more economical to operate. The next meeting will be held 8 p. m., February 3, at the Jonathan Club.

Electrical Development and Jovian League.

An enthusiastic meeting of the Electrical Development and Jovian League was held at the Hof Brau, San Francisco, Wednesday noon, January 6. As this was the first meeting of the new year, President-elect Fred Leggett outlined his plans for the term to come. First among these was the assigning of the details of each meeting to a chairman of the day who would be responsible for the speakers and entertainment. Next was the appointment of a new committee known as the live wire committee, whose duty is to stimulate attendance. The effectiveness of their first effort was indicated by a gathering of 112 men. President Leggett also announced the various league committees, as has been previously reported in these columns, and then introduced Mr. Geo. C. Holberton, manager of the San Francisco Gas & Electric Company, as chairman of the day. After some fine singing by employees of the Pacific Gas & Electric Company, Mr. Holberton introduced George Drake Smith, representative of the General Electric Vehicle Company, who told of a new plan of "Selling Juice by the Mile," whereby the San Francisco Gas & Electric Company will furnish and maintain Exide batteries for electric trucks in service in San Francisco.

The Jovian Electrical League of Southern California.

A well-attended luncheon of the League, held at Christopher's, Los Angeles, on January 6, was ably presided over

by N. W. Graham, who had prepared a most entertaining program. Following the customary introduction of guests and the reading of reports, Tribune Pieper announced that the League would interest itself in the selection by the various local civic societies, of a Southern California Carnival Queen. Splendid musical selections were rendered by Vera Stanley and Herr Van Berg, who were accompanied by Dick Alter. C. S. Walton gave a very entertaining three-minute talk on Ira J. Francis. A highly instructive lecture was then delivered by Walton J. Wood, the Public Defender of Los Angeles, a position created in that city, and one which is unique in the annals of criminal procedure. He stated that about one-half of the cases handled by the Superior Court are turned over to the Public Defender, instead of young and unscrupulous lawyers, who were formerly assigned by the court to the unfortunate defendants. By thus aiding these unfortunates in obtaining a fair trial and frequently securing probation and positions for them, rather than a prison term, considerable money is saved by the county. Vampires, in the form of the young lawyers, are thus eliminated and over-punishment prevented. The Defender, who works in perfect harmony with the District Attorney, handles about 800 cases per month. Civil cases are also handled and about three-quarters of all the labor or wage collection cases are adjusted out of court.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The commission has rendered a decision authorizing the Roseville Telephone Company, of Roseville, Placer County, to issue 400 shares of capital stock of the par value of $10 per share.

The commission has issued an order extending to May 31, 1915, the time within which the Midland Counties Public Service Corporation may issue $275,000 of its first and refunding 6 per cent 40-year bonds, to be used in retiring a like amount of bonds of the Midland Counties Gas & Electric Company. The corporation is also granted a similar extension of time within which to issue $546,000 of the same bonds to be used in retiring a like amount of bonds of the Coalinga Water & Electric Company.

The commission has rendered a decision authorizing the Butte Valley Telephone Company, operating in Siskiyou County, to issue 22 shares of stock of the par value of $10 per share. The proceeds are to be used for the construction of a telephone line along the Moore-Richardson road, just outside of the city limits of Doris, Siskiyou County.

The commission rendered a decision holding that the Standard Oil Company, Associated Oil Company, Producers Transportation Company, Associated Pipe Line Company and General Pipe Line Company of California are common carriers and public utilities, and subject to the Public Utilities Act of the State of California. The commission finds that these companies are controlled by five interests, namely, Standard Oil Company, Associated Oil Company, Independent Oil Producers Agency, General Petroleum Company and Kern Trading & Oil Company, which together control 95 per cent of the entire oil production of the State. These pipe lines are held to be public utilities in the transportation of crude oil, petroleum or the products thereof by means of pipe lines from the San Joaquin Valley oil fields.

The commission has issued a supplemental order authorizing the Southern California Edison Company to issue $518,000 face value of its 5 per cent bonds at not less than 87½ per cent. The company proposes to use the proceeds from the sale of these bonds in retiring notes in the sum of $558,000.

The commission has rendered a decision authorizing the San Diego Consolidated Gas & Electric Company to renew three promissory notes totaling $55,000 held by H. M. Byllesby & Company and bearing interest at the rate of 7 per cent per annum.

NEWS OF WASHINGTON PUBLIC SERVICE COMMISSION.

The commission has established a service department. It is the idea of the commission to carry out the law with reference to the inspection of service of the utilities in the different cities of the state.

The commission is seeking to have its power extended to the extent enjoyed by similar commissions in other states in the matter of certificates of convenience and necessity. The law which it seeks from the legislature will provide that no public service corporation shall begin the construction of a line or system, or an extension, without first obtaining from the commission a certificate that the present or future public convenience and necessity require, or will require, such construction.

The report of the commission shows 156 telephone companies in operation, seventy electrical companies supplying current for power and light, and twelve companies furnishing gas to consumers in this state. A total of 43 steam lines are transacting business in Washington, while 19 are electrically operated.

The Seattle council is taking steps toward directing the corporation counsel to bring action before the state public service commission against the Puget Sound Electric Railway, commonly known as the Tacoma Interurban, for lower fares within the city limits of Seattle, and against the Seattle, Renton & Southern Railway to prevent its charging of passengers who carry packages, in addition to the usual fares.

COMMITTEES FOR 1915 CONTRACTORS' CONVENTION.

Arrangements are rapidly being perfected for the reception and entertainment of delegates to the annual convention of the National Electrical Contractors' Association which is to be held at San Francisco, July, 1915.

The following committees have been appointed:

General—W. S. Hanbridge, Chairman.

C. F. Butte	A. H. Brainager	H. M. Hope
A. L. Hughes	Geo. Sittman	H. C. Reid
W. D. Kohlwey	W. H. Kirsten	C. L. Chamblin
M. Fortini	L. R. Boynton	Lee Gilpin
	Geo. Smith	

Finance—C. F. Butte, Chairman.

Geo. Brouillet	W. Gribble	D. E. Harris
E. M. Cutting	F. Watts	

Reception and Dance—W. D. Kohlwey, Chairman.

Jas. Barry	C. C. Hillis	W. Hooker
	Mr. St. John	

Boat Ride—M. Fortini, Chairman.

W. W. Briggs	O. Orrick	R. D. Holabird
H. A. Sayles	M. Quinn	

Lunch on Boat Ride—Geo. A. Sittman, Chairman.

H. H. Daly	Brewster Hall	W. Neiman
	M. L. Scobey	

Dinner-Dansant—W. H. Kirsten, Chairman.

R. M. Alvord	Chas. Wiggin	Sam'l Taylor
W. L. Neelands	L. Levy	V. Kean

Auto Rides—L. R. Boynton, Chairman.

R. Wolden	W. Hutton	F. Fowden
	W. L. Goodwin	

Open Meeting—N. M. Hope, Chairman.

W. S. Berry	G. Holberton	C. V. Carter
C. E. Heise	P. Decker	

Reception—H. C. Reid, Chairman.

C. Renstrom	A. E. Drendell	D. Gallivan
S. B. Gregory	C. J. Newberry	P. B. Hyde
	F. H. Poss	

Zone—A. L. Hughes, Chairman.

H. E. Sanderson	F. Thall	H. H. Hoxie
C. C. Caven	J. T. Jarvis	

Exposition—C. L. Chamblin, Chairman.

M. Steele	H. B. Squires	E. Dwyer
A. E. Rowe	W. Dixon	

Music—Geo. Smith, Chairman.

A. Meinema	W. Thompson	B. Hansen
A. V. Olsen	G. Davis	

Oakland—Lee Gilpin, Chairman.

C. Gilson	Geo. King	R. Gilson
B. Hill	E. Claussen	J. Genlser
	H. Kimball	

Press and Publicity—W. S. Hanbridge, Chairman.

A. H. Halloran	J. Redpath	E. B. Strong

Decoration—A. H. Brainager, Chairman.

W. W. Perry	C. Mitchell	H. Engle
O. Vitt	H. Hasselbach	

CALIFORNIA ASSOCIATION OF ELECTRICAL INSPECTORS

Section of N. A. E. I.

C. W. Mitchell, President. Arthur Kempston.
Wm. G. Pennycook, Vice-Pres. B. C. Hill, Executive Comm.
John W. Carrell, Secretary-Treasurer, 814 Scott, San Francisco.

The purpose of this organization is to standardize the common practice in electrical construction with the National Code as the general standard.

Questions pertaining to electrical construction will be answered in these columns, but only from the point of view of the Code. This is a voluntary organization and the answers published under this heading must not be construed as authoritative, or binding. No attempt will be made to correllate the answer from the several Inspection Districts, as an occasional difference of opinion will tend to induce further study on subjects. All questions will be passed upon by an executive committee.

Address all communications to the secretary.

The California Association of Electrical Inspectors recently in regular session passed a resolution inviting the National Fire Protection Association to abridge and reassemble the rules pertaining to wiring of buildings in one group.

They also submitted an example of such abridgement and list of rules involved. The effect of this abridgement would be to reduce the size of the Code by fifty per cent.

Example of Abridgement.

Metallic Armor Systems:

(Rigid and flexible conduit, armored cable and metal moulding).

(a) Must be continuous from outlet to outlet, to junction boxes or cabinets; must properly enter and be secured to all fittings, and entire system must be mechanically secured in position.

(b) Must, for service connections or main feeder circuits, be run continuously into main cabinet or gutter surrounding panel board, as the case may be.

(c) Must be equipped at every outlet with an approved outlet box or plate. Outlet plates must not be used where practicable to install outlet boxes.

At exposed ends of metallic armor where wires pass from system without joint, tap or splice (but not at fixture outlets), approved fitting having separately bushed holes for each conductor must be provided.

In buildings already constructed where conditions are such that neither outlet box nor plate can be installed, these appliances may be omitted, providing the metallic armor ends are bushed and secured.

Departure from this rule may be authorized by special permission.

(d) Must, where entering junction boxes, cabinets and at all other outlets, etc., be provided with approved bushings or fastening plates fitted to protect wire from abrasion or by means of other devices specially designed and approved for the purpose.

(e) Junction boxes must always be installed so as to be accessible.

(f) For cabinets, junction boxes, outlet boxes or plates, installed for concealed work in non-fireproofing construction, front edges must not be more than one-fourth inch back of completed plaster surface and if this surface is broken or incomplete it shall be repaired so as to close all gaps or spaces about edges. For wooden surfaces the front edges must be flush with completed outer surface or may project therefrom.

(g) Wooden or composition cabinets must not be used with metallic armor systems.

(h) Must have metallic armor permanently and effectually grounded to water piping, gas piping or other suitable grounds provided that when connections are made to gas piping, they must be on the street side of the meter. If the metallic armor system consists of several separate sections, the sections must be bonded to each other, and the system grounded, or each section may be separately grounded, as required above. Where short sections of metallic armor (or pipe of equivalent strength) are used for the protection of exposed wiring on side walls, and such metallic armor or pipe and wiring is installed as required by No. 26 e, the metallic armor or pipe need not be grounded.

Metallic armor and gas pipes must be securely fastened in outlet boxes, junction boxes and cabinets, so as to secure good electrical connections.

If metallic armor, couplings, outlet boxes, junction boxes, cabinets or fittings, having protective coating of non-conducting material such as enamel are used, such coating must be thoroughly removed from threads of both couplings and metallic armor, and such surfaces of boxes, cabinets and fittings where the metallic armor or ground clamp is secured in order to obtain the requisite good connection. Grounded pipes must be cleaned of rust, scale, etc., at place of attachment of ground clamp.

Connections to grounded pipes and to metallic armor must be exposed to view or readily accessible, and must be made by means of approved ground clamps to which the ground wires must be soldered.

Ground wires must be of copper, at least No. 10 B. & S. gage (where largest wire contained in metallic armor is not greater than No. O. B. & S. gage), and need not be greater than No. 4 B. & S. gage (where largest wire contained in metallic armor is greater than No. O. B. & S. gauge). They shall be protected from mechanical injury.

The ground on the metallic armor system is not to be considered as ground for a secondary system. (See No. 15).

(i) Must, for alternating current systems, have the two or more wires of the same system enclosed in one metallic armor.

(j) All bends must be so made that metallic armor will not be injured.

For conduit, the radius of inner curve of any elbow must not be less than 3½ inches, and there must not be more than four quarter bends (or equivalent) from outlet to outlet, the bends at outlets not counted.

For armored cable, the radius of inner curve of any bend not to be less than 1½ inches.

(k) Armored cable, when installed in so-called fireproof buildings in course of construction or afterwards if exposed to moisture, or where it is exposed to the weather, or in damp places, such as breweries, stables, etc., must have a lead covering placed between the outer braid of the conductor and the steel armor.

The lead covering is not to be required when the cable is run against brick walls or laid in ordinary plaster walls unless same are continuously damp.

(l) Metal moulding where passing through a floor must be carried through an iron pipe extending from the ceiling below to a point five feet above the floor, which will serve as an additional mechanical protection and exclude the presence of moisture often prevalent in such locations.

Where the mechanical strength of the moulding itself is adequate, this ruling may be modified to require the protecting piping from the ceiling below to a point at least three inches above the flooring.

Where such mouldings pass through a partition the iron pipe required for passing through floors may be omitted and the moulding passed directly through, providing the partition is dry and the moulding is in a continuous length with no joint or coupling within the partition.

Backing for metal moulding must be secured in position by screws or bolts, the heads of which must be flush with the metal.

The N. E. Code rules involved are: Numbers 3, 4, 8, 12, 15, 16, 17, 18, 19, 23 to 39 inclusive, 42 and 43.

Numbers 12 and 15 are involved only in so far as they pertain to wiring of buildings.

TRADE NOTES.

Chas. C. Moore & Company have moved their San Francisco offices to commodious quarters in the Sheldon Building.

Bids will be opened January 19th by the Board of Public Works at Seattle for furnishing one boiler, engine, generator and switchboard for power house at the Tuberculosis Hospital and Sanitarium at Richmond Highlands.

The Cutler-Hammer Manufacturing Company, Milwaukee, had an interesting exhibit at the New York Automobile Show which opened January 2d. The principal device shown was the electric gear shift for gasoline automobiles which was mounted on a Winton transmission. The operation of this device, which eliminates the hand shifting of gears, is controlled by push bottons mounted in the center of the steering wheel. The Winton Six is one of the 1915 cars to be furnished with electric gear shift. C-H single button push-and-pull automobile lighting switches are shown in various combinations for the control and dimming of automobile lights. Cutler-Hammer Pyroplax fireproof insulating material is also shown and samples of such parts as radiator caps, switch sub-bases, fuse boxes, motor terminal blocks, etc., are mounted on a display board. A similar exhibit will be made at the coming Chicago automobile show.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—Sacramento Valley Telephone Company, $500,000, shares $100 each, subscribed $2500, by J. R. Edwards, J. F. Cambbell and F. Lukenbell.

POCATELLO, IDAHO.—The Gate City Electric Supply Company has been organized with a capital stock of $10,000. D. M. Griffin of Salt Lake City being president.

BAKER, ORE.—G. W. South, F. A. Phillips et al., of Medical Springs, have formed the Medical Springs Telephone Company, which proposes to build a telephone line to connect that section with the county seat.

VANCOUVER, WASH.—Portland-Vancouver & Northern Railway Company has filed articles of incorporation. The head offices will be here. Henry Crass, mayor of this city, is president. The object is to connect Portland and Vancouver by an electric line.

PORTLAND, ORE.—The Oswego Lake Water, Light & Power Company has filed articles of incorporation. The purpose of the company is to furnish water to the city of Oswego and to install a power plant. It is incorporated by A. S. Pattullo, Frederick H. Strong and Isaac D. Hunt, all of Portland, and is capitalized at $5000.

ILLUMINATION.

PACIFIC GROVE, CAL.—This city in a very short time will have an entirely new street lighting system.

FORT BRAGG, CAL.—H. F. Milliken has announced his intention of applying for a franchise for a gas plant.

BUENA PARK, CAL.—The Southern Counties Gas Company expects to make an entrance to this city in the near future.

SANTA ANA, CAL.—The council has decided to enter a new contract with the Southern California Edison Company for street lighting.

FULLERTON, CAL.—The board of supervisors has granted to the Southern Counties Gas Company a franchise to lay pipes for gas in certain sections of Orange county.

LOS ANGELES, CAL.—Bids are being taken for furnishing electricity and installing lights in the Norwalk Lighting District, in accordance with specfications on file with the board of supervisors.

HONOLULU, T. H.—Substantial improvements to the electric light service and police and fire alarm system are planned, all to be installed if possible before the end of 1915. The cost of the street lighting system is estimated at $18,000.

PHOENIX, ARIZ.—Manager Farish and City Electrician Dodge have completed plans for an extension of the ornamental street lighting system. It has been decided to extend the Central avenue system north and south to the city limits.

DALLAS, ORE.—This city is about to enter into a contract with the Oregon Power Company to light its streets with 100 candlepower incandescent lights for a period of five years at $22 per light per year. About 90 lamps will be required.

ANAHEIM, CAL.—The city has entered into a contract with W. H. Houts, providing for 59 five light ornamental posts to be installed on Center street from Clementina to Philadelphia, and on Los Angeles street from Broadway to Cypress, work to begin at once.

SAN FRANCISCO, CAL.—A new system of street lighting has been ordered for Van Ness avenue by the supervisors. Two high candle power tungsten lamps on each trolley pole is the order to the Pacific Gas & Electric Company and there are eight trolley poles in each of the 31 blocks between Market street and the bay.

TRANSMISSION.

ASHLAND, ORE.—The substation of the Oregon-California Light & Power Company was destroyed by fire. The loss is estimated at $15,000.

AUBURN, CAL.—The Bell Electric Company is to build a new power line three miles long to furnish power to the farms in Shirland Tract & Long Valley. The line will start in Auburn.

TULARE, CAL.—A contract for installing the conduit and cable for the electrolier system was let by the council to E. F. McEwin of Ocean Park for $4300. The system when completed will light 17 blocks.

VENTURA, CAL.—The board of supervisors has granted the Pacific Light & Power Corporation a franchise to furnish light and power to the Simi Valley, the Las Posas and Camarillo sections and nearly to Saticoy.

ENUMCLAW, WASH.—The Puget Sound Traction, Light & Power Company has secured an option on the power plant here and will extend the service to Wilkeson, Carbonado, Burnett and other points in that direction.

NORTH YAKIMA, WASH.—The Pacific Power & Light Company has made application to the board of commissioners of Yakima county for a 50 year franchise granting the right to operate transmission lines in the town of Selah.

EL PASO, TEX.—The Eighty-five Mining Company, operating in the Lordsburg District, will install an electrical hoist at the plant in the near future. An electric generating plant is being installed on the Jim Crow Mine in the Stepple Rock District.

GRANTS PASS, ORE.—The Rogue River Public Service Corporation expects to have two more 400 h.p. turbines in operation at its Gold Hill plant by February 1, giving a total capacity of 1200 h.p. F. W. Dodge is engineer and manager at Gold Hill and G. W. Sorenson secretary at Grants Pass.

SEATTLE, WASH.—The Puget Sound Traction, Light & Power Company has consummated the purchase of 3000 acres of land in Skagit county, together with water rights on Baker River. This step has been pending for a long time as a part of the plan of Stone & Webster to develop electric energy at low cost for manufacturing purposes.

VANCOUVER, B. C.—The British Columbia Electric Railway spent almost a million dollars in making extensions and improvements during 1914. In October of last year its third unit on the Jordan River was completed. The company constructed one of the largest concrete dams in the world for gathering the waters of the Jordan River. The cost of this structure alone was $565,000.

SILVER CITY, N. M.—State Engineer James A. French has granted the Socorro Mining & Milling Company an extension until January 25th for the completion of its power plant at Mogollon. The power plant will generate 1000 h.p., which will be used in operating the company's mine and mills and other mines and mills in the district. Current for lighting will be transmitted to the town of Mogollon. Water of the Whitewater creek is to be utilized.

TRANSPORTATION.

PORTLAND, ORE.—The Portland & Oregon City Railway Company has accepted the franchise granted by the Milwaukie city council and has started to build its line through Milwaukie.

PORTLAND, ORE.—The city council of Portland has decided that the United Railways must pay to the city five per cent of its gross earnings each year for the privilege of handling freight cars over the city streets.

SAN FRANCISCO, CAL.—The operation of the United Railroads cars on California street between Sixth and Thirty-third avenues, ceased last week and the United Railroads began tearing up the old rails and ties to make room for the construction of the Municipal Railway line, which F. Rolandi is building under contract with the board of public works. This new city road, which will extend from Geary street and Second avenue to California street and Thirty-third avenue, will be completed about March 1st.

SAN FRANCISCO, CAL.—The city engineer is to look over a new plan for surmounting the Church street hill, a plan brought in by Supervisor McCarthy, who said it had been drawn by a young engineer who figured that the work could be done for $65,000. For the purpose of bringing the city's rights to a decision, the board adopted a resolution of intention to extend the Stockton street line down Fourth street to Third and Townsend, taking over the use of the United Railroads' tracks on payment of one-half their cost.

WATERWORKS.

SANTA MONICA, CAL.—The city council is planning for an adequate water supply.

LOS ANGELES, CAL.—John Carner has been granted a franchise to lay down and maintain for 40 ears a system of water pipes along streets in the Mills & Wicks Subdivision.

PORT TOWNSEND, WASH.—City Engineer Sadler is working on plans for the changing of the Olympic Water System mains where they cross the Portage and bids will soon be called.

PORTLAND, ORE.—Construction of the proposed 16 in. water main for the reinforcement of the water supply throughout Irvington and contiguous districts will be started immediately. It will cost about $50,000.

SAN DIEGO, CAL.—As a result of a resolution passed by the city council, City Attorney Cosgrove will go ahead at once with condemnation proceedings for the purchase by the city of Cuyamace Water Company's holdings.

SAN DIEGO, CAL.—Contractors have completed moving the old filter plant from Chollas to the Lower Otay reservoir and have begun the contruction of the new unit. Construction of the Bonita pipe line is being held back pending settlements for right of way.

BEAUMONT, CAL.—At a meeting of representatives of the water company and Messrs. Sewell, Thompson and Tillery, plans for acquiring the water system for the city were discussed and in all probability plans will be ready to submit to the public in the near future.

SAN DIEGO, CAL.—The city council has authorized the superintendent of finance to employ Hydraulic Engineers J. B. Lippincott and M. M. O'Shaughnessy, as experts to make a report upon the value of the Volcan water system, with a view of developing the system for city use.

ALBUQUERQUE, N. M.—Mayor Boatwright is shaping plans for a more adequate water supply for the city. City Engineer Gladding will make an estimate of erecting and operating a municipal plant. The water company will be asked to name the figure at which it will sell its plant to the city.

SANTA MONICA, CAL.—This city has made a second application to the Los Angeles water board for a supply of Owens River water. The State Railroad Commission will be asked to make an appraisement of properties so the city will have data upon which to calculate in event a bond issue is contemplated for a water system.

LAS VEGAS, NEV.—Newel K. Leavitt of this city has made application to the state engineer of Nevada to appropriate public waters. Such appropriation to be made from surface and underground waters by means of pumps and to be converted by means of pipes, irrigation ditches and flumes and used for irrigation and domestic purposes, the water not to be returned to stream.

SAN MATEO, CAL.—Trustees of the Leland Stanford Jr. University have decided to take over the active management of the Bear Gulch Water Company from the estate of late Senator Felton, and to develop the system until an abundance of water is assured to consumers in Palo Alto, Woodside, Menlo Park and vicinity.

LOS ANGELES, CAL.—The board of supervisors will receive bids up to February 8th for a franchise for a system of water pipes, in certain streets beginning at the intersection of Central and Slauson avenue, Hooper and Florence avenues and certain other streets. The franchise gives the right to distribute water to the adjacent territory for domestic and other uses.

LOS ANGELES, CAL.—The board of public service commissioners have been promised by the council that immediate action would be taken in regard to supplying the Hollywood District with municipal water. The principal point to be determined is whether money shall be raised through the creation of an assessment district or the issuance of bonds.

PHOENIX, ARIZ.—C. M. Shannon is promoting a project of a huge pumping proposition in the Casa Grande region. Within a mile of the famous Casa Grande ruins, 1400 acres are held by the company. On the main line of the Southern Pacific across the Gila and about 20 miles away, there will be erected a power plant, engines will be fed with tank fuel oil trains. A transmission line will carry electricity to the pumps.

PENDLETON, ORE.—W. R. Hinkle has just completed the survey of the reservoir in Alkali Canyon above Echo, and the feed canal to supply the reservoir. This work was done for the Western Land & Irrigation Company, and when built will supply the project with water for summer use. The plans will be presented to the state engineer for his approval in the near future. The construction of this system will entail an investment of about $250,000.

STANFORD UNIVERSITY, CAL.—In view of opening the peninsula foothill property of Stanford University for home sites, the University trustees are planning the construction of a dam below Searsville Lake to impound the flood waters of the San Francisquito Creek, which flows through the college holdings. Vanderlyn Stow, business manager of the university properties, has been given authority by the board of trustees to proceed with the plan.

SAN DIEGO, CAL.—It is probable that the electors of San Diego will vote on the proposition of purchasing the Volcan water system at the regular election to be held in April. The proposition carries with it the voting of $1,000,000 in bonds as first payment. The purchase price is to be $2,500,000 and an additional $1,500,000 to be expended by Henshaw in construction and not to be paid by the city until the expiration of 40 years, if so desired.

SAN FRANCISCO, CAL.—Mayor Rolph and the advisory water committee have decided on March 30 next as the date for the bond election for the purchase of the Spring Valley properties. It is proposed to submit to the people the question of the purchase of the Spring Valley properties for $34,500,000. This figure includes all of the water-bearing properties useful to this city. At this price the advisory water committee has stated that the property will pay for itself and is taken as one index that the figure of $34,500,000 is not excessive.

PORTLAND, ORE.—Engineer D. D. Clarke of the Water Bureau, in his annual report, recommends that steps be taken for the better protection of the Bull Run pipe lines near the Mount Hood power plant of the Portland Railway, Light & Power Company, where an immense flume of the latter company has broken several times. He says the flume should be constructed in a more substantial manner or removed to some other location. Preparations are being made for the construction of the new dam at the headworks.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXXIV SAN FRANCISCO, JANUARY 23, 1915 NUMBER 4

[COPYRIGHT 1915 BY TECHNICAL PUBLISHING COMPANY]

THE BEST CONTROL OF PUBLIC UTILITIES

BY FRANK G. BAUM.

(After a general discussion of the need for class rates for different classes of service, the author outlines methods for determining them. This article is slightly abridged from a paper presented before the San Francisco Section of the American Institute of Electrical Engineers, Jan. 22, 1915.—The Editor.)

It must be evident to anyone who has given serious consideration to the subject of the control of public utilities that it is necessary always to have in mind the following as an axiom:

The best control of a utility is that which develops an eagerness and ability on the part of the company to furnish the service, and an equal eagerness and ability on the part of the consumer to purchase the service.

Note that there must be both eagerness and ability on each side in order to promote the best interests of the business. Now how are we to determine the best way in which to develop this eagerness and ability on the part of the company and the consumer?

1. There must be developed a diversified use of electric energy.

2. Fair public service commissions must act as boards of arbitration between the company and the consumer.

3. The rate of return on the investment must be liberal.

4 (a). There must be confidence in the company and its rates, and class rates are absolutely necessary for the development of the business.

4 (b). Uniform class rates for a system or territory are advisable where one commission regulates the rates.

5. There must be some incentive for the company to make economies in construction and operation.

[The paper then gives an explanation of these five requisites. As the first three are self-evident to engineers they are omitted here, as is also a part of 4 (a) proving the equity of varying rates for different classes of service.]

Lake Almanor, Storage Reservoir for Great Western Power Co., a Typical Commission Regulated Utility in California.

The lighting consumer's rate is much higher than the rate to the power consumer because:

First—The investment and cost of operation to serve the lighting consumer are greater than the investment and cost of operation to serve the power consumer, and

Second—Much more important, the total energy consumed by the power consumers is much greater than that used by the lighting consumers for the same peak demand.

The confusion that exists in the case of the lighting rates comes from charging for the same unit of service. In railroad freight and passenger rates there is a natural difference in the method of charging, hence there is no confusion. In the lighting and power busi-

ness there is no such natural method of charging a different unit rate. It has been occasionally urged to charge the power user on a sliding scale of charges, starting at the same rate charged the lighting consumer. If the power consumer made the same demands as the lighting consumer, his rate and total charge would be the same as the lighting consumer up to the substation. The scale of rates charged the power consumer would drop rapidly, in excess of this amount, and his average rate could be approximately the same as it would be under the ordinary power rate schedule. But there is objection to this on the part of the power consumer. It is believed, however, that until some form of schedule of rates or class rates is devised which strikes all consumers alike, there will be difficulty in educating the public as to the reason for the difference in the rates. It is believed that equitable "class rates" as herein described will remove the present misunderstanding.

The general method used in determining class rates for a system is as follows: Divide the total amount of money to be earned by the power and light class by the sum of the peak demands of the two classes. This gives the demand charge per kw. Multiply this demand charge by the peak demand of the class. This gives the total revenue to be earned by the class. Divide this revenue by the kilowatt-hours consumed by the class and we obtain the average class rate per kw.-hr.

An example will probably make this plain, although it is quite elementary to the managers of utility properties. Assume that we have installed a waterpower plant having a normal capacity of 10,000 kw., and that it has cost, including transmission line and substation, $2,000,000. To make the example as simple as possible we will assume that the company contracts to supply the lighting of a city wholesale, so that the company shall earn 8 per cent on its investment in addition to the operation, depreciation and maintenance charges, etc. The total annual consumption is, say, 15,000,000 kw.-hr. The consumer agrees to pay 10 per cent in excess of the rate determined from costs in order to have a margin of safety.

Then for the cost of service we have:

Interest			8 per cent	= $200,000
Depreciation	1.5	per cent		
Maintenance	1.5	"		
Taxes and Insurance	1.0	"	4 "	100,000
Total			12 per cent	$300,000
Operation and management				150.000
				$450,000

$$\text{Cost per kw.-hr.} = \frac{45{,}000{,}000 \text{ cents}}{15{,}000{,}000 \text{ kw.-hr}} = 3 \text{ cents per kw.-hr.}$$

Adding 10 per cent for safety margin = 3.3 " " "

There is a daytime power load of 45,000,000 kw.-hr. annually, available in the same town, that can be supplied from the same substation, with the same power plant and transmission system. However, in order to make a rate attractive enough to get the power load, it is agreed that the power consumer shall pay only 6 per cent on one-half the investment which necessitates that the lighting consumer pay 10 per cent. Each consumer agrees to pay 10 per cent in excess of the rates determined from absolute costs in order to have a margin of safety. The costs then chargeable to the lighting consumer will be:

Interest		10%	of one-half investment,	$125,000
Depreciation	1.5%			
Maintenance	1.5%			
Taxes, ins., etc.	1.0%	4%	" " "	50,000
Total		14%		$175,000
One-half operation and management cost				75,000
Total charge to lighting consumer				$250,000

$$\text{Cost per kw.-hr.} = \frac{25{,}000{,}000 \text{ cents}}{15{,}000{,}000 \text{ kw.-hr.}} = 1.66 \text{ cent per kw.-hr.}$$

With 10 per cent added as margin of safety, rate = 1.836 cent per kw.-hr.

The result to the lighting consumer is to reduce the rate from 3.3 cents to 1.836 cent per kw.-hr., in spite of the fact that his interest rate has been increased from 8 per cent to 10 per cent.

The rate to the power consumer will be:

Interest		6%	of one-half investment,	$75,000
Depreciation	1.5%			
Maintenance	1.5%			
Taxes and ins.	1.0%	4%	" " "	50,000
Total		10%	" " "	$125,000
One-half operation and management cost				75,000
				$200,000

$$\text{Cost to power consumer per kw.-hr.} = \frac{20{,}000{,}000 \text{ cents}}{45{,}000{,}000 \text{ kw.-hr.}} = 0.444 \text{ cent per kw.-hr.}$$

10% added for safety margin gives rate = 0.4888 cent per kw.-hr.

If now a consumer could be found to take the power from 12 p.m. to 6 a.m., when the other two consumers are not using it, a rate could be made by which his interest charge could be less than 6 per cent and still both the other consumers would benefit, as the operation charges would be increased very little.

Except for the cost of water storage which should be apportioned to kw.-hr. output, all charges on a water power plant are demand charges and should be apportioned to peak demands of power and light classes.

Let us take now a typical case as applying to the above plant. The load curve in Fig. 1 may be assumed to represent such a case. Here we have the peak demand of the lighting class equal to 7500 kw. and the peak demand of the power class of 7300 kw. As a result the yearly charges of $450,000 are spread over $7300 + 7500 = 14{,}800$ kw., instead of being spread over the 11,000 kw. of the total peak. As a result the yearly demand charges are reduced from

$$\frac{450{,}000}{11{,}000} = \$41 \text{ (practically) to } \frac{450{,}000}{14{,}800} = \$30.50$$

or the demand charges are reduced practically to 75 per cent of what they would be if there were only one class of consumers. This shows the advantage of the diversity factor 1.35. Now charge each class in proportion to class peak demand (see calculations in Fig. 1.) As a result the light consumers pay $7500 \times \$30.50 = \$228{,}750$ of the total and the power consumers pay $7300 \times \$30.50 = \$221{,}250$ for power at the substation.

The average charge for lighting is

$$\frac{22{,}875{,}000 \text{ cents}}{15{,}000{,}000 \text{ kw.-hr.}} = 1.52 \text{ cent, and adding 10}$$

per cent gives 1.67 cent per kw.-hr.

Similarly, the average power charge is

$$\frac{22{,}125{,}000 \text{ cents}}{45{,}000{,}000 \text{ kw.-hr.}} = 0.49 \text{ cent, and adding } 10\% \text{ gives } 0.539 \text{ cent per kw.-hr.}$$

Here we see the effect of the load factors; the lighting load factor being only 22.6 per cent, while the power load factor is 70.5 per cent. The average load factor is 62.5 per cent. Without the power consumer the rate to the lighting consumer would be

$$\frac{45{,}000{,}000 \text{ cents}}{15{,}000{,}000 \text{ kw.-hr.}} = 3 \text{ cents, and adding } 10\% \text{ gives } 3.3 \text{ cents;}$$

or in other words, the lighting rate is reduced nearly one-half. Without the lighting consumer the power rate would be 1.1 cent. The mutual benefit is clearly shown by the example.

The following table shows the effect of the power load in reducing the charges to the lighting consumer:

Case.	Total peak.	Light peak.	Power peak.	Proportionate charges. Light.	Power.
A	10,000	7,500	2,500	75 per cent	25 per cent
B	10,000	7,500	5,000	60 "	40 "
C	10,000	7,500	7,500	50 "	50 "

The lighting consumer pays 100 per cent of all power charges if there are no other consumers, but by the addition of power consumers the lighting charges for power at the substation may be practically reduced one-half. From the substation to the consumer, of course, each class of consumer must bear its share of the additional expense.

There will be further differences of rates to different classes of lighting and power consumers, but the application of the principle is the same as in the above case. For the power consumers we start with the total amount to be earned by all the power consumers and by proportioning these charges according to the demands of the class, the total charge to the class is determined, and from the kilowatt-hours consumed by the class its average rate is determined. The method is believed to be scientific and can be made fair to all consumers under any circumstances.

In applying this method to a steam plant, all demand charges, that is, all plant investment and operation, would be proportioned to peak demand of power and light, and fuel and water only be charged as energy and proportioned to kilowatt-hour consumption of the two classes.

It is not intended in this paper to go into the question of the proper rates under each class, but rather to limit the paper to a discussion of the general principles of class rates in such a way as to make clear to the consumer and the investor the necessity and justification for such rates, to the end that there will be a better understanding of the electrical business as an extremely important part of the economic development of any community.

The principle at the bottom of all rates is to make the plant earn all it can during every hour of the day so that the burden of the investment may be distributed. That is, to make the rates within the reach of the lighting consumer, it is necessary to make low power rates in order to distribute the charges over as many kilowatt-hours as possible.

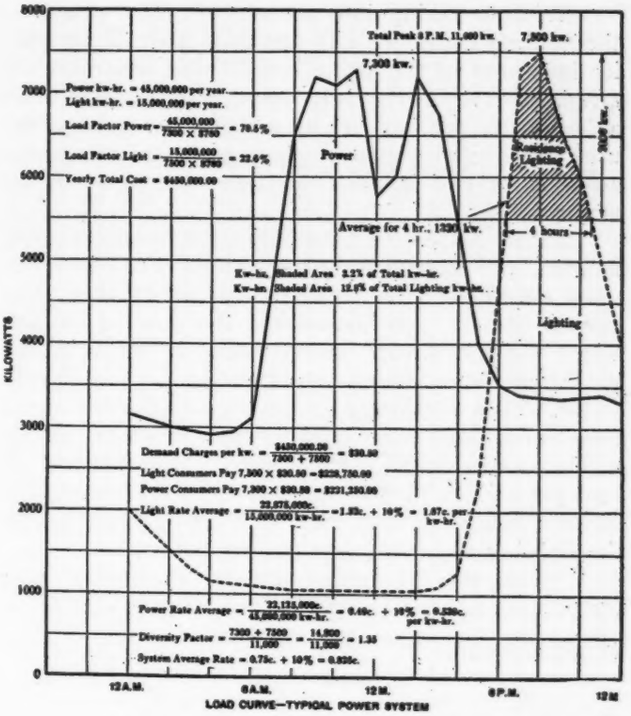


Fig. 1. Class Charges to Substation.

The same principles apply to nearly all public utilities. As a precedent for rates of this kind we have the railroad, telegraph, express, and postal rates.

Generally the power service requires a steam reserve plant for service insurance, and usually, during periods of low water, storage water must be used and the steam reserve plant must be operated part of the time. It is evident that the cost of oil for the steam reserve and the cost of water storage, both representing energy, should be apportioned to the kilowatt-hours consumed by each class. In general the total charges for power delivered to substations are made up in two items:

First: Demand charges, which should include interest, maintenance, depreciation, operation and management.

Second: Energy charges, which should include oil and water for steam reserve plant and the cost of storage water, as these are the only items that should be proportioned to kilowatt hours output.

The total charges above would be divided for light and power classes into demand and energy charges, as follows:

$$\text{Light class demand charge} = \frac{\text{total demand charge} \times \text{light peak}}{\text{light peak} + \text{power peak}}$$

$$\text{Power class demand charge} = \frac{\text{total demand charge} \times \text{power peak}}{\text{light peak} + \text{power peak}}$$

$$\text{Light energy charge} = \frac{\text{total energy charge} \times \text{light kw.-hr.}}{\text{light kw.-hr.} + \text{power kw.-hr.}}$$

$$\text{Power energy charge} = \frac{\text{total energy charge} \times \text{power kw.-hr.}}{\text{light kw.-hr.} + \text{power kw.-hr.}}$$

Without taking into account the fact that it is the lighting consumer who demands most of the service insurance of the steam reserve and who uses the steam reserve inefficiently because it is only used a few hours per day, let us make a few general figures to see what the steam reserve adds to the energy costs of the two classes over those shown by the example in Fig. 1.

Let us assume that the low-water period is three months, or one-quarter of the total kilowatt-hours must be supplied by steam power or its equivalent storage water. Let us assume the cost of oil and water for the steam reserve plant at 0.4 cent per kw.-hr. and allow the same per kw.-hr. for the storage water. Then 15,000,000 kw.-hr., or one-quarter of the total, must come from storage water or steam power, making a total of $60,000 per year. This will add 0.1 cent per kw.-hr. to the total and to each class of consumers' rates, the final rate then being 1.77 cent for the lighting and 0.639 cent for the power.

Adding this 0.1 cent per kw.-hr., the average rate for power at the substation in the above example is:

$$\frac{45{,}000{,}000 \text{ cents}}{60{,}000{,}000} + 0.1 \text{ cent} = 0.75 + 0.1 = 0.85 \text{ cent},$$

and adding the 10 per cent for margin of safety, the average rate is 0.935 cent per kw.-hr. The average fair lighting rate is, however, 1.77 and the average fair power rate is 0.639 cent.

It is seen, therefore, that the lighting rate is nearly double the average, and the power rate about one-third less than the average rate. It is fallacious, therefore, to apply the average rate for a system to the different classes of consumers, or to different districts or towns. Each class, town or district gets the advantage of the diversity factor (usually about 1.3) for the system, but the rates for the class, town or district should be determined, by the method here used.

If a town, for example, has a lighting peak of 100 kw., the lighting consumers in that town must pay

$$\frac{100}{7500}$$

of the total paid by all the lighting consumers on the system. The rate per kilowatt-hour for the town will be determined by dividing the total to be paid by the kilowatt-hours consumed, and therefore the rate per kilowatt-hour depends on the consumers themselves; that is, on how much they consume.

As a check on the above average lighting cost of power, let us see what the average cost of power for the residence lighting would be if supplied by a steam plant. The residence lighting may be taken to extend four hours per day and the following figures, then, are taken from Fig. 1:

Peak load steam plant	2,000 kw.	
Average load steam plant 4 hours	1,320 kw.	
Average load steam plant 24 hours	220 kw.	
Kw.-hr. per year, $220 \times 8760 =$	1,927,200	
Cost of plant	$200,000.00	
Interest	8 per cent	
Maintenance and depreciation	4.5 per cent	
Operation and management, etc.	2.5 per cent	
Total cost	15 per cent	$30,000.00
Energy cost for fuel and water only, 0.5 cent per kw.-hr. = 1,927,200 × 0.005 =		9,636.00
Total cost per year		$39,636.00

$$\text{Cost per kw.-hr.} = \frac{3{,}963{,}600 \text{ cents}}{1{,}927{,}200 \text{ kw.-hr.}} = 2.05 \text{ cents}$$

Demand cost	1.55 cents
Energy cost	0.50
	2.05 cents

This rate applies to the generating station.

The cost of supplying power, therefore, to the residence lighting, will probably average 2 cents per kw.-hr. A sliding scale would take care of differences in the individual lighting rate.

The steam plant capacity to take care of the four-hour peak is 2000 kw., or 20 per cent of the entire plant. The kilowatt-hours output is, however, only 3.2 per cent of the total output and only 12.8 per cent of the total lighting load. This brings out clearly the reason for the high unit cost for the consumer taking only a small amount of energy for lighting for about four hours per day.

It is generally known that the railroads prefer the freight to the passenger business, but it is not so generally known that the power companies, at least those having water power, prefer power business to lighting business. And again, commercial business is generally more attractive than residence business. This is evidenced by the fact that certain companies confine their operations to the commercial districts. One of the reasons for this condition is the large amount of capital necessary to serve the small consumer.

Thus it is seen that the attractiveness of the business really varies almost inversely as the rate per kilowatt-hour charged, which is directly contrary to public opinion.

In practice, the difficulty of determining average equitable rates need not be serious. The most important item is the amount of power consumed by each class, and this can be determined; the item of the maximum demand of each class or the proportionate cost to be charged to each class of business cannot be so accurately determined, but if an error of 10 per cent were made in the example of power and light cost to substations, it would, say, increase the power rates from 0.75 to 0.825 cent, and reduce the lighting rates from 6 to 5.7 cents. An error of 10 per cent in the annual cost of operation would mean an error of $300,000 added to one class and subtracted from the other. The total amount of revenue to be earned can readily be determined, and, if we get the class rates within 10 per cent of the correct amount, there should be no serious complaint.

It is a cut-and-try method, but past practice has already largely determined class rates. The main thing is to have class rates that will develop the business and that will give consumers the right idea of the cost of their class of business, and not have the lighting consumer confused by having his mind on the power rate for an entirely different class of business and supposing that this rate should apply to him.

[To be continued.]

Fusible boiler plugs which fail to operate, thus causing boiler explosions and loss of life, are being investigated by the U. S. Bureau of Standards. Tin plugs have frequently been found to deteriorate by conversion to oxide. The durability of tin plugs would therefore appear to be a serious question.

INDUSTRIAL USES OF FUEL OIL

BY F. B. DUNN.

(Continued.)

Smelting Furnaces Fired With Oil.

Many difficulties attend the use of coal or coke in reverberatory and roasting furnaces used for smelting and refining metal ores. If coking coal is used, the volatile matter is quickly driven off, leaving a heavy bed of slow-burning coke. Ordinary coal reduces the atmosphere of the furnace at each charge, producing a period of incomplete combustion, during which no sulphur can be oxidized by the oxygen of the air. This feature is particularly undesirable in reverberatory furnaces in which copper ores are treated. If pulverized coal is used much difficulty is encountered in regulating the proper amount of air. Trouble is also caused by the settling of ash and unburned fuel on top of the charge and by the clogging of the flues.

The use of fuel oil obviates all these difficulties, for when the fires are regulated, the flame is clear and steady, the furnace temperature even, and there is no

Record of a Run of a Reverberatory Furnace and Analysis of Charge.

Total charge per furnace day, tons	666
Oil fired per furnace day, bbl	421
Coal equivalent of oil fired, tons	124.00
Total charge per bbl. of oil, tons	1.58
Oil, bbl. per ton of total charge	0.63
Equivalent gross coal, as percentage of total charge	18.60

Components of Charge as Percentage of Total Charge.

Calcine	60.1
Seconds	16.8
Converter hot slag	9.0
Fettling	3.0
Limestone	9.6
Flue Dust	0.6

Slag (Assay and Analysis).

Cu	0.40
SiO	44.00
Fe	34.30
CaO	8.60
AlO	7.40
Oxygen rates	2.72
Grade of matte, per cent Cu	40.40

Draft.	Water inches.
Bridge	0.35
Throat	0.83
Stack	1.25
Temperature of verb, degrees F.	1010
Infusibility factor of calcine	1.5
Burners, large Steptoe, high pressure	7

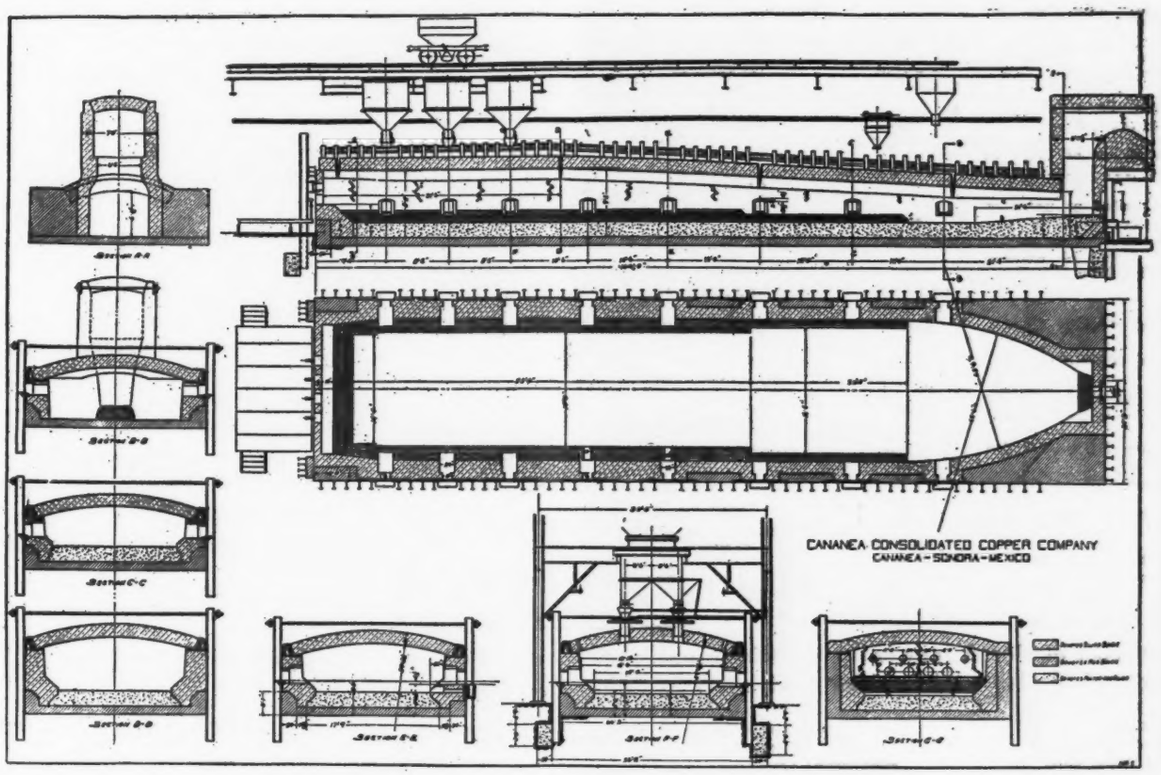


Fig. 54. Plan and Section of Cananea Oil Fired Furnace.

smoke or soot. This desirable condition may be maintained for weeks, allowing the sulphur in the ores to combine with the oxygen of the air at all times. Other advantages accruing from the use of oil fuel in reverberatory furnaces are its cleanliness, low cost of handling, freedom from sulphur, and the increased capacity of production made possible by its use.

The following table shows a record performance at the Steptoe plant, McGill, Nevada, on December 17, 1911:

In addition to these many inherent advantages, great economy can be attained by the use of a waste heat boiler in conjunction with oil firing, savings of as much as 50 per cent of the fuel having been recorded by this device.

Fig. 54 shows the plan of such a furnace at Cananea, Mexico; the records of a typical run in this furnace show that during a period in which 8140 tons of material were handled, 7003 bbl. of oil were used, of which only 3901 bbl. were chargeable to smelting, the

remaining 3102 bbl. being recovered in equivalent steam.

The attached table shows typical operating conditions of two reverberatory furnaces:

Details of Modern Reverberatory Furnace Smelting in America.

	Cananea (Mexico)	Steptoe (McGill) (Nevada) (Coal) Fired	(Oil) Fired
Number of Furnaces	2	5	
Average tonnage per day	192.3 (174.4 T.M.)	239— (216.8 T.M.)	322— (292.1 T.M.)
Average weight of Charge	7½ to 9 tons (6.8-8.2 T.M.)	14 tons (var.) (12.7 T.M.)	14 tons (var.) (12.7 T.M)
Average tons charge per ton Fuel	5.86	3.24	5.80
Average temperature of charge entering furnace	500° to 550°F (260°-288°C)	500°F approx (260°C)	500°F (260°C)
Kind of Fuel used	California Crude Oil		California Crude Oil
Character of Charge:			
Calcine (Hot)	50.0%	61.8%	56.8%
Calcine (Cold)	....	....	....
Flue Dust	50.00	1.2	1.4
Conv. Slag	....	9.8	7.1
Secondaries (Cold)	....	12.5	15.2
Flux and Fettling Ores (Cold and Wet)	....	15.2	19.5
Dimensions of Hearth	100′ x 19′ (30.48 x 5.79 m)	120′-10″ x 19′ (36.83 x 5.79 m)	
Dimensions of Fire Box	None	None	
Top of Grate Bars to top of Bridge	None	33-1-4″ (84 cm)	
Top of Grate Bars to underside of Roof	None	85-3-8″ (217 cm)	
Height of "Verb" or Vulcatory above Skim Plate	36-1-2″ (93 cm)	36″ (91 cm)	
Dimensions at Throat of Furnace	7′ x 1′-9″ (2.13 x .53m)	6′-10″ x 3′ (2.08 x .91 m)	
Dimensions of flue beyond Throat (damper flue)	7′ x 6′ (213 x 183 cm)	(Not Given)	
Draft in inches of water at Bridge	(No data)	.2″-.5″ (.5 cm-1.3 cm)	
Draft in inches of water at Throat	.13″ (.33 cm)	.7″-1.2″ (1.78-3.05 cm)	.9″ (2.29 cm)
Draft in inches of water—Main Flue beyond Boilers.	.9″ (2.29 cm) 115 sq. ft.	1.25″ (3.18 cm)	
Dimensions of Main Flue	10′ x 12′ (3.04 x 3.66 m)	29′-3″ x 8′-6″ (8.91 x 2.59 m)	
Dimensions of Chimney	187′ x 12′-6″ (57. x 3.81 m)	300′ x 15′ (91.44 x 4.57 m)	
Height of top of Stack above Grate	198′ (60.35 m)	316′-9-1-2″ (96.55 m)	
Temperature of Gas at Bridge	2700°-2800°F (1482°-1538°C)	2700°-3000°F (Est) (1482°-1649°C)	
Temperature of Gas at Throat	2300°-2400°F (1260°-1316°C)	2200° F. (approx.) (1205°C)	
Temperature of Gas at Far Side of Boilers	500°F (260°C)	800°F (approx) (427°C)	
Average Boiler h.p. per Furnace from waste heat	971 h.p.* (984 C.V.)	486 h.p. (493 C.V.)	632 h.p.. (641 C.V)
Per cent Fuel recovered as steam	56.62	32.3	33.8
Per cent Fuel recovered from ashes	None	5.05	
Ratio of Concentration	4.96	3.31	3.40
Tons charge per million B.t.u.	0.1574	0.122	0.171

*Economizes are installed at this point beyond boilers.

The use of fuel oil in blast furnaces presents much more serious difficulties. In the process of smelting with these furnaces, solid carbon plays a very important part, both mechanically and chemically. The lumps of coke used serve to keep the charge from becoming too densely packed, thus permitting the hot gases to penetrate more freely; and the incandescent carbon performs certain chemical functions which need not be discussed here. Thus coke or charcoal cannot be entirely replaced by oil fuel in the blast furnace; and while a few experiments have been conducted, with economical results, in which oil and coke have been used together, much difficulty has been encountered in the slagging of the furnace tuyeres.

These tests were carried out without radical changes in the construction of the furnace; coke was used in the ordinary way, and the oil was injected at the tuyeres with a hot blast. Other tests have been made with specially constructed furnaces, in which the oil is supposed to be converted into a gas at the mouth of the tuyeres by means of elaborate atomizers, the combustion taking place in the channels leading to the tuyeres. These experiments were carried on with high gravity oils; and while the results were satisfactory from the chemist's standpoint, the expense was too great to make the method commercially practicable.

Another difficulty in the way of using oil as a fuel for blast furnaces lies in the fact that if the burners are placed in the bottom of the shaft, the burner tips will soon be melted off. The operation at the start may be perfectly satisfactory; but as the temperature increases the zone of fusion is lowered, the molten metal cannot withstand the great weight of material in the shaft above it, with the result that it is forced down unitl in contact with the burner tips, with the result that the latter are burned off. Even if this extreme difficulty does not arise, the sagging of the charge is soon great enough to close the air channels upon which the oil depends.

[To be continued.]

The cost of electric power for electric furnaces or electrochemical plants with a high load factor as estimated by Dorsey A. Lyon in U. S. Bureau of Mines Bulletin 77 is as follows:

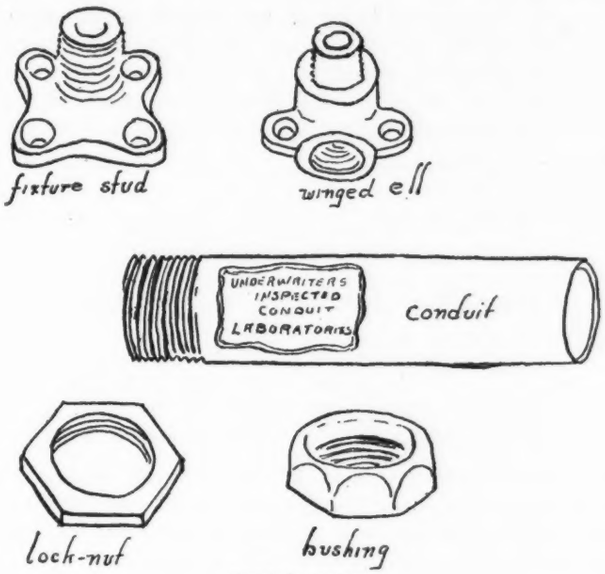
Location of Plant.	Power Company.	Nature of power,	Cost per kw.-yr.	Product at the Present Time.
Braintree, England	Lakes & Elliott Steel Foundry	Gas engine	$110	Steel.
Sheffield, England	Municipal System	Steam	87	Steel.
La Praz, Savoie, France	Electrometallurgical Co. of France	Hydroelectric	16	Aluminum, steel, carbide.
Livet, Isere, France	Keller, Leleux & Co.	Hydroelectric	13	Ferro-alloy.
Ugine, Savoie, France	Girod Electrometallurgical Co.	Hydroelectric	18	Ferro-alloy, steel.
Bonn, Germany	Municipal System	Steam	92	Steel.
Remsheid, Germany	Lindenber Steel Co.	Steam	87	Steel.
Volklingen, Germany	Rochling Iron & Steel Co.	Steam, gas	83	Steel.
Meraker, Norway	Meraker Electric Smelting Co.	Hydroelectric	8	Ferro-alloys, carbide.
Notodden, Norway	Norwegian Saltpeter Co.	Hydroelectric	7	Nitrates.
Rjukan, Norway	Norwegian Saltpeter Co.	Hydroelectric	5	Nitrates.
Tyssedal, Hardanger, Norway	Tyssedal Power Co.	Hydroelectric	10	Carbide, cyanamide.
Trollhatten, Sweden	Royal Power Plant	Hydroelectric	9 to 12	Iron, zinc, ferro-alloy, paper.
South Verron, Vt.	Connecticut River Power Co.	Water and steam	53	General.
Shelburne Falls, Mass.	Connecticut River Power Co.	Water (secondary)	29	General.
Turners Falls, Mass.	Turner Falls Power Co.	Water and steam	60	General
Turners Falls, Mass.	Turner Falls Power Co.	Water (secondary)	26	General.
Rumford Falls, Me.	Rumford Falls Power Co.	Hydroelectric	26	Paper.
Niagara Falls, U. S.		Hydroelectric	26	Electrochemical.
Niagara Falls, Canada		Hydroelectric	20	Electrochemical.
South Carolina	Southern Power Co.	Hydroelectric	25	Nitrates.
South Chicago, Ill.	Illinois Steel Co.	Steam, gas	43	Steel.
South Carolina	Southern Aluminum Co.	Hydroelectric	25	Aluminum.
Snake River, Idaho	Southern Idaho Power Co.	Hydroelectric	12	General.
Heroult, Cal.	Northern California Power Co.	Hydroelectric	16	Pig iron.

INSIDE WIRING METHODS

By JOHN CARRELL

Rigid Conduit Systems.

Rigid conduit is made of mild steel tubing of weight and cross section about equal to ordinary commercial pipe and with metal treated to resist corrosion. The interior is made smooth, covered with a metallic coating or enamel so as to present a polished surface to the wire. The completed conduit is in lengths of ten feet, each provided with Briggs' standard pipe threads and one coupling. It is used in buildings of fireproofed construction or where the installation of wires by means of porcelain insulators is not feasible or desired. The only limitations to its use are physical or chemical conditions. The smallest conduit used for lighting installations is the nominal ½ in. pipe having an actual inner diameter of .62 in.

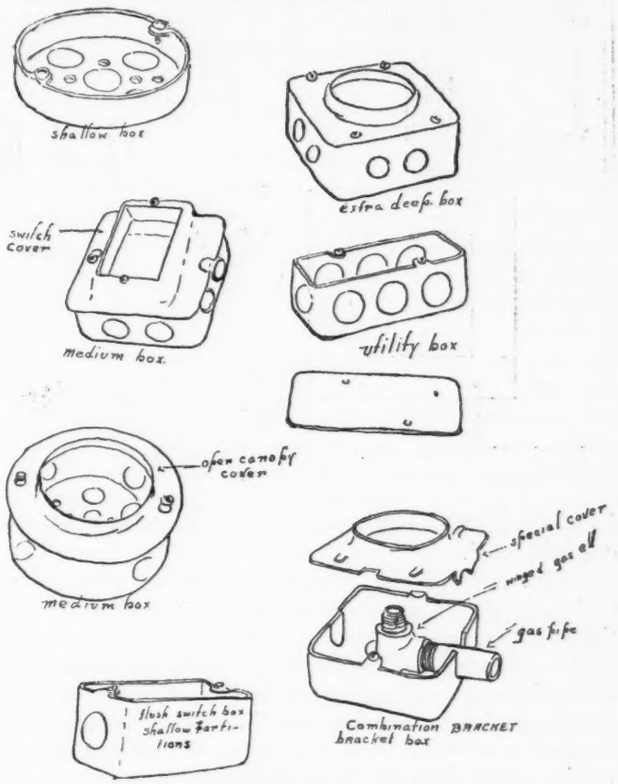


Conduit Parts.

The object of a conduit system is to form a wire-way which will render the enclosed system permanently accessible or so that, if necessary, the wires in any part of the system may be withdrawn or replaced without disturbing any completed surface. To this end the conduit is run continuously between places of access to the wire-way where it is secured to metal boxes or fittings especially designed for the purpose used. Sometimes the end of the conduit, properly equipped, serves as a terminal point. There should be the fewest possible number of bends between these outlets.

Outlet boxes used in connection with conduit systems vary in form, size and construction, according to location and use. Their uses are legion and the types for each use manifold. Those for the run of the work are of pressed steel with wall thickness .078 in. minimum; are drilled for screws to secure the boxes or to attach accessories, and are equipped with "knockouts" or removable round plates to provide for the entering of conduit. Cast metal boxes of compact form, made to include female nipples and designed to be supported by screwing on the conduit, are largely used for exposed work. Boxes of watertight construction are used in wet places or where vapors exist.

Junction boxes are used where necessary to form a junction place for conduits at other points than at outlets. They are constructed on the general lines of pressed steel outlet boxes, but often of larger size; they are also frequently inserted in long runs of conduit to shorten pulling in distances.



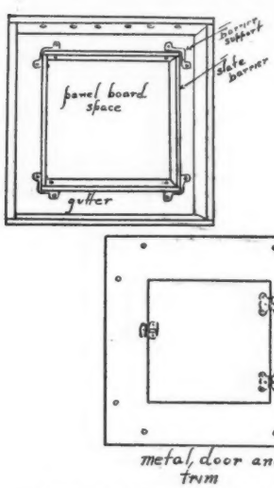
Outlet Boxes for Concealed Work.

Cabinets are usually made from sheet steel of thickness varying from a minimum of No. 16 U. S. metal gauge, according to size. Doors are fitted to close against rabbets or provided with turned, overlapping flanges so as to be dust tight. When a cabinet encloses a panel board, a gutter or wire-way is provided, partitioned from the panel space with barriers of metal or of insulating material, from which wires enter to their respective terminal connections, each through a bushed hole of proportionate size.

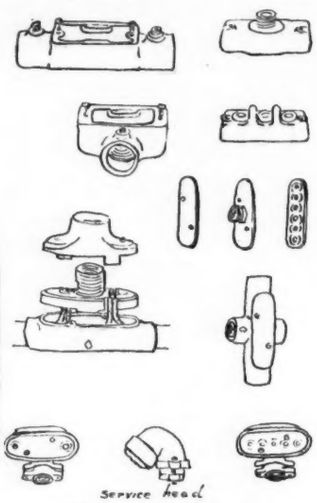
The installation requirements for cabinets, outlet and junction boxes are that they be well secured in place with outer edges flush with the completed surface or projecting therefrom. To entirely fulfill the object of a conduit system cabinet gutters and junction boxes must be so installed that they may be kept accessible and so that the trims or covers thereof will be completely removable when the several screws which fasten them are withdrawn.

For electrical reasons all metal parts of a con-

duit system must be grounded. This is usually accomplished by running a copper wire from a convenient place in the system to a water pipe or to a gas pipe or supply or "street" side of the gas meter. The connection is made between the two piping systems with clamps equipped with lugs into which the connecting wire is soldered. To maintain the continuity of this ground connection through outlet boxes, cabinets, junction boxes, etc., necessitates the electrical bonding of the conduit to these fittings; also outlet boxes must be bonded to gas pipes, at combination outlets. This "ground principle" is a large



Metal Cabinet for Small Panel Board.



Outlet Fittings for Exposed Work.

factor in determining the type of construction used in conduit work.

The ends of conduits are bonded to metal walls of boxes and cabinets by means of locknuts or thin, threaded washers. Two locknuts are set up tightly on each conduit thread, forming a clamp with the wall of the box between. Each end of conduit is equipped with a bushing, or extra end designed to protect the insulation of wire from abrasion. A device, secured to the outlet box by stove bolts and clamped to the gas pipe by tightening a machine screw is used at all combination outlets.

As a rule conduit should not pass over any surface for a distance greater than 5 ft. without a support equivalent to a well secured pipe strap unless otherwise secured by the construction of the building.

Where conduit is to be run in damp places, such as on the exterior of a building or underground or where it is to be embedded in concrete the joints should be filled with a conducting compound to prevent the entrance of moisture.

Figuring labor on a conduit job is usually done by allowing so much time for each unit of the several divisions of work, a subject touched upon in a preceding article. The labor on running pipe, pulling in wire, splicing and testing is commonly based on the number of feet of pipe. This method, while more accurate than figuring the time on the basis of outlets, is somewhat erratic. There is another way.

Example: On a class C building with conduit run in furred floor above, one circuit had 9 outlets, 8 switches and required 200 ft. of pipe. The time required to complete job, including all work, except setting switches, was 3.5 days.

Setting 17 boxes	1 day
Running 200 ft. pipe	2 days
Pulling-in, splicing and testing	4 hrs.
	3 days, 4 hrs.

If this job had the same quantity of pipe but only 5 outlets, then with same method of figuring the time would be 2 days 6½ hours. The actual time to run the pipe to the five outlets should be 1 day and 3 hrs. and the time for pulling in, splicing and testing, 2¾ hrs. If 200 ft. of pipe were run to one outlet the time should be under 5 hrs. for the pipe.

The amount of labor on any job should be based not only on the number of feet of pipe but also on the number of points wired to. If the job in the example were just twice the size it would be reasonable to expect that the amount of labor would be double.

Setting 34 outlet boxes	2 days
Running 40 ft. pipe	4 days
Pulling-in, etc.	1 day
	7 days

Taking the product of No. of feet of pipe × outlets.

1st job = 200 × 17 = 3400
2d job = 400 × 34 = 13600
√ 3400 = 58.399 √ 13600 = 116.8
58.399 : 116.8 : : 7 : 3.5 or twice the labor.

Find for each type of job the average feet of pipe run to a certain number of outlets in one day and extract the square root of these pipe × outlets, thus securing a constant. Find the square root of pipe × outlets on job estimated and divide by constant. If figures are too large for convenience, reduce to units of 1000 ft.

[To be continued.]

LETTER TO THE EDITOR.

Arc Lamp Photometry.

Sir:—Mr. Rogers' comments in your issue of December 26, 1914, on my article on Arc Lamp Photometry in your issue of October are very interesting.

It is an open question, however, whether it is advisable to attempt to reply to Mr. Rogers. Certainly it is unnecessary to enter into any controversy in regard to the commercial integrity or common business honesty of either of the big manufacturing companies as their position is too high to be materially affected by anything that either Mr. Rogers or myself may write. In the same way it is probably unnecessary to comment on certain parts of Mr. Rogers' criticism of my method of testing. I certainly did not intend to advocate testing 4 ampere lamps on 6.6 amperes or testing 6.6 ampere lamps on 4 amperes, nor would I advocate testing anything on "an unknown current." It does not seem likely that any one would be seriously mislead by my article as it is obvious that a test to be of any value must be made under service conditions. As a result of hundreds of tests on arc lamps, using both the method outlined by Mr. Rogers and the method outlined briefly in my article, I find there is no appreciable difference in the results ob-

tained by the two methods. The method outlined in the article is merely more convenient.

In the same way it is probably unnecessary to comment on Mr. Rogers' statement, that in regard to diffusing globes. Mr. Rogers, of course, understands that no competent arc lamp man would make tests with diffusing globes and his comments are therefore, in a measure, unwarranted.

In regard to Mr. Rogers' defense of the magnetite lamp, it would seem that this is also unnecessary and uncalled for as there was no intention whatever to in any way belittle the commercial position of that lamp. Here again, anything that Mr. Rogers or I may say or write will have very little effect. The magnetite or metallic flame lamp as made by the two large companies at the present time is without a rival in its particular field. It gives a beautiful white light, has an excellent distribution curve, is reasonable in first cost, easy to maintain, and quite efficient.

My principal reason for commenting on Mr. Rogers' article is not to take issue with him on any of these points but because it is possible that some of us may perhaps get a wrong impression in regard to certain points which he brings out, and because I believe Mr. Rogers' letter serves to emphasize a very important point. For example, he illustrates a prismatic reflector in which practically all the light above the horizontal plane is thrown out at a useful angle in a practically parallel beam. It does not seem likely that Mr. Halvorson and the very practical body of engineers associated with him have built a refractor which actually concentrates this light in a narrow band as illustrated. In all probability the beam is spread somewhat so as to get a distribution over a considerable angle and so as to give a better distribution on the street. Mr. Rogers states that the lamp with the refractor has a maximum candle power of 900, this being directly comparable with the 630 candle power mentioned earlier in his article. In other words he would have us believe that the practical illumination on the working plane will be 50 per cent greater. In this connection it is well known that the use of candle power ratings for concentrating refractors or reflectors is open to great objections. For example, from Mr. Rogers' statement, we would expect that the illumination on the street would be that produced by a point source of 900 candle power. As a matter of fact Mr. Rogers is probably unjust to the new refractor as it will give a practical illumination at a certain angle much greater than would be indicated by a 900 candle power rating. This, of course, is because the law of inverse squares does not apply to a concentrated beam of light. In a searchlight, for example, in which the rays are nearly parallel, there is practically no difference in the illumination of a plane at 16 ft. or on a plane at 8 ft. Where the concentration is in only one direction, as indicated by the illustration in Mr. Rogers' article, the illumination theoretically diminishes inversely as the distance and practically somewhat faster.

It would seem to me that Mr. Rogers' statement in regard to 900 candle power is misleading and unless he gives us some limiting data, such a statement is without practical value. It certainly would not be a true measure of the efficiency of the prismatic refractor.

The original reason for writing this letter is that I think Mr. Rogers' letter brings into relief the point that I touched on briefly in my original article which I would like to enlarge on as follows: Photometric tests are extremely valuable to the arc lamp designer and are a positive necessity if true progress is to be made in the art. They are, however, of only secondary importance to the users of lamps and too much stress should not be laid on them in connection with the selection of lamps. The practical aspects of illumination are too often lost sight of in the consideration of purely academic laboratory questions. Mr. Rogers, for example, has evidently made a test of a lamp equipped with a special refractor and has found that at a certain distance he gets 50 per cent more light. He therefore rates the lamp 50 per cent higher than the lamp without the refractor. Probably if he had gone twice as far away he would have gotten 1200 candle power or more as a value. Such tests and ratings are absolutely valueless for any practical purpose. This is practically true in connection with street lighting. An arc lamp for city illumination should be reasonable in cost, pleasing in appearance, and quiet in operation. None of these points are in any way determined by a consideration of distribution curves. From considerable practical experience I question whether the average citizen can tell whether a lamp is giving 300 candle power or 600. He can, however, tell whether it is pleasing in appearance or not, and he will comment on the presence of bright bands or shadows on the street. It is my personal opinion after spending a great deal of time with my eye glued to a photometric tube, that one learns more about arc lamp design by watching the lamps in practical operation on the street than can be learned by laboratory tests. So far as the ultimate users of the lamps are concerned their own good sense and powers of observation are undoubtedly of more value than any amount of photometric tests, and certainly photometric tests or statements founded on such tests that are incomplete or misleading are worse than useless.

In regard to the light given from the various lamps I would again repeat that my experience is that the illumination produced nearly always falls short of what would be expected from the manufacturers statements. The later type of lamps, among which is the magnetite, come much closer to the expected performance than any of the earlier forms, but my experience, which has been considerable and which has been backed up by a large number of tests, causes me to think that the manufacturers are somewhat over-optimistic. It should be borne in mind that I am talking about the lamps in actual operation on the street and not about laboratory tests, especially tests with concentrating refractors and reflectors. It should also be understood that this is a general statement and is not aimed at any lamp or manufacturer, and certainly not against the magnetite lamp. It should also be understood that my comments on Mr. Rogers' letter are not in the nature of a criticism of the apparatus he is writing about but only a criticism of his presentation of its virtues, which I can readily see would be many.

Yours very truly,

Los Angels, Cal. FORD W. HARRIS.

INDUCTIVE INTERFERENCE.

(Here is presented a continuation of the stenographic report of the discussion on the Report of the Committee on Inductive Interference to the Railroad Commission of California before the San Francisco Section of the American Institute of Electrical Engineers.—The Editor.)

[Continued.]

J. E. Woodbridge: Answering Mr. Bowie's discussion of the rulings on switches, I wish to take exception to his remark that there is no foundation in fact for these rulings. I also wish to dissent from his opinion that it is not commonly recognized that air switches are objectionable from this point of view.

Speaking first with reference to the published data on the subject, I call your attention to the fact that the rise in pressure in the power circuits is no measure of the inductive effect on communication circuits. While I am not altogether convinced that oil switches cause a higher rise in pressure than air switches, and would not be convinced except by a long series of tests, even if the oil switch does cause a higher rise in pressure we could not conclude from that that the oil switch causes a greater inductive effect on parallel communication circuits. The commonly recognized fact—which Mr. Bowie does not recognize—is based on this reasoning, with which I think we will all have to agree: An oil switch has been found to open the circuit within a relatively small number of cycles, usually I believe from 6 to 10, according to the speed of the switch and the frequency of the circuit. An air switch worked under load at high voltage breaks the circuit in a relatively large number of cycles, usually I believe 100 or more cycles. It is inconceivable that the three arc of a triple-pole air break switch can be made to break as nearly simultaneously as the three arcs of a triple pole oil switch. The time interval after the breaking of the first arc and before the breaking of the final arc introduces a very large unbalanced voltage or current or both in the power circuit which is broken by the switch. This large unbalance is what we have defined in the report as the residual. This residual is frequently under load conditions of sufficient magnitude to give on a parallel telephone circuit, what is best defined by the slang expression "a bat in the ear."

Referring now to rule 2 j, "Use of Air Switches," the second sentence in this rule reads as follows: "This applies to the entire power system, any circuit of which is involved in a parallel, unless such switching is so remote as not to cause harmful transient disturbances in the communication circuits." This might perhaps have been better worded; and it was the spirit of the wording "unless such switch is so remote (or of such a character) as not to cause harmful transient disturbances in the communication circuits." This additional wording is really involved in the rule, as a remoteness of only a few feet might be sufficient to avoid harmful transient disturbances, providing the switching was of such a character as not to cause such disturbances.

I am getting back to Mr. Babcock's point, that the rule is aimed at the effects of the switch, and not at the form of the switch.

The Chairman: I think the Allies are a little in advance. I would like to hear from the other side if we have any representatives who wish to carry the discussion further. It seems that difference of opinion is what makes engineers, and I am sure we have several engineers present. Is there anybody else who would discuss the matter? Professor Ryan, I would ask you to express a few opinions.

Harris J. Ryan: I was asked some academic questions in regard to a certain case that came up in a communication parallel in the southern part of the state. It may be of interest to us all here, more especially because the case does not seem to be covered by the report. The report is a wonderful document, not only because of its character, the work upon which it reports, and the manner in which that work was accomplished, but likewise because of the spirit of co-operation that has pervaded the entire undertaking.

The report, as I understand the matter, confers upon the power companies the privilege of operating, perhaps temporarily, in an emergency, a long tap line connected from a power circuit, through a bank of 3-phase Y-connected auto transformers, the neutral not grounded, the voltage from the power system side 65,000, to the tap line side, say at 50,000.

Now under those circumstances you will note that you have a certain residual voltage as it is referred to in the paper, harmonics more particularly, and a fundamental if there is unbalancing exerted through the line condensers and active in setting up a residual current through such line condensers. The line condensers on the tap line connect to ground, and on the power side connect back from ground, and the single phase action of the fundamental, third harmonic, fifth, ninth, etc., as they are present, residual voltages will be active in setting up a single phase current. By the emergency connection that was made up in this manner, a telephone line, that paralleled the power circuit for a distance was put quite out of commission for the time being. Now one cannot open up the ground and put in an ammeter and read these residuals, but one can set up in the laboratory a model of this state of things, and imitate the condensers that are present necessarily on the line, and thus find that the condensers are quite important because of the circuit they establish through earth shunting the auto bank. From the laboratory results one must expect that there is at work in these cases quite an interference current. I fear, unless we go on record accordingly in the discussion of this paper, that some might not think of the consequences, and install equipment as stated and be disappointed in the result.

L. B. Cramer: Mr. Babcock has cleared up some things that were not exactly clear as I read the report, as to what kind of switches might be used. I must say that I do not believe I can quite agree with Mr. Woodbridge about the speed that he speaks of in the air break switches. While certain air-break switches might operate at such speeds I have seen air-break switches where an attempt was made to cut down the speed; and I have a certain engineer in mind who made a rather rash statement to a man who was in a position to furnish a very good type of air switch, that if he could show on the oscillograph tests certain things, his company would be in a position to give a rather large order for the switch. He was so thoroughly convinced of what the results would be if records were taken that he made this statement; and after the tests were made he was so much taken back that he had nothing to say; and since that time the company I understand has placed an order even larger than what the man said they would do before the tests were made; but he was rather slow in being convinced after he saw the records, and made largely with equipment of his own company. He was hardly willing to give in then.

I haven't any tests or anything to back up other than the oscillograph records or what the inductance effect or the effect on the communicating circuits might be in opening such air break switches; but I have had receivers to my ear at times when such switches were opened; the effect on certain lines, especially on railroad companies where the communicating circuit is carried on the same poles as the transmission circuit, or separate piles on opposite sides of the right of way, is to give same somewhat of a bat in the ear; but where it is carried on a separate pole line on the opposite sides of a right of way, the sensation to the ear is noticable but not extremely objectionable—not so that a dispatcher having a headset would necessarily advise a man who is going to open the switch to let him know when the switch is going to be opened, so he would not have his ear shocked.

There is one thing in connection with superimposed telephone circuits that I have not had time to read all that is contained in this report; but in glancing over it hurriedly I would judge that the inductive effects were supposed to have serious results.

I have in mind a circuit that was carried on the same pole line, a high voltage transmission line; and it was discovered that that line might be simplexed, and they thought probably that the telephone service would be of very little use, but it was desired to do this from the telegraph standpoint; and the result was very surprising to find in this particular case after the line was simplexed, that the telephone service over the line was better than it was before.

There has been carried out by this committee a rather elaborate series of tests in certain localities with certain climatic conditions. The question came to me, "I wonder if in some other part of the United States these same results repeat themselves?"

W. M. Smith: Might I ask any of the committee who are present whether any static effects were considered? Perhaps they were ruled out because it was a committee on inductive interference; but some years ago I was connected with one of the earliest installations of single phase railroading in the East—11,000 volts. It was on the Erie railroad in the state of New York. I was responsible for the overhead construction, and I did not have to bother with the telegraph end of it. That was up to the railroad company. A number of experts were called in from the Western Union and the General Electric, and they had quite a time and gave it up. Finally an old expert out of the Western Union office of New York, who was supposed to be almost down and out, from old age, was sent up there to recuperate; and after spending about six weeks he devised some scheme whereby the very evident interference between the 11,000 trolley and the telegraph line of several wires alongside the track was pretty well overcome. I did not attempt to go into the matter myself except to see what luck he had in avoiding the disturbance. He devised some very simple resistance and condenser schemes, if I remember rightly, and the results were quite satisfactory from the railroad company's standpoint. They were conducted under the auspices of the superintendent of telegraphs of the railroad and worked out all right. This particular interference, according to my remembrance, was supposed to be static rather than inductive. I have been wondering whether static effects were considered or received consideration by the committee, as distinguished from mixed up inductive effects; because from this experience I had it struck me that they have something to do with it sometimes.

It looks to me in general as though the report was a finely constructed document. I am not only interested in the matter of co-operation which Mr. Babcock mentioned in particular; but also the careful technical language which was employed in presenting the matter. I think anyone who reads the report with any care cannot fail to be struck with the very earnest attempt on the part of the man or men who drafted it, to make it as absolutely clear as possible. I think the report from that standpoint alone is quite an unusual and practical document. I cannot but get the impression from it that it puts up some pretty difficult practical problems to the power man and the railroad man. Apparently the man with a single phase proposition, no matter how technically attractive it may be, has got to pretty near go on his knees hereafter before he can receive consideration—or at least such seems to be the import of the decision. Whether or not that may retard any future development I don't know; but one element of the report struck me, and that was, it might be quite difficult for a company desiring to construct a power line in a congested district, where there were already a number of power lines and a number of telephone leads in existence—it might be quite difficult and very expensive, in view of the other restrictions that the state of California has placed an overhead construction of high tension current, it might be quite difficult to get a new line into existing territory, perhaps in some cases almost impossible, in view of the physical distance of the separations required by the existing requirements; and also by the new imposition—I won't call it an imposition—I don't mean impcsition in the sense of an injustice—but the burden I will say of giving very much more consideration to the telephone interests than has heretofore been the habit with power men.

A. H. Babcock: There is just one point that Mr. Smith has developed I wish to emphasize, and I thank him for bringing it up. He has stated very clearly the point of view of many people in discussing this problem, viz: that the telephone circuits are not to be considered, but it is the effect on the development of railways or power companies that must be considered. It is not so much the technical point that I want to speak to now, but it is the equity of the thing, What is the greatest good for the greatest number? Does it consist in interfering with our telephone service, with our communication with each other? When we take down a receiver on our desk and want to talk to somebody else, is that to be considered at all? If it is not, we might just as well stop talking. It is the big thing and the broad thing that we are concerned with—not the immediate effect on the power circuit or railroad circuit or telephone circuit, but the sum total of the effects on the transaction of your business and my business with which we are concerned; and when Mr. Smith or anyone else calls attention to the effect on the development of the railway circuit and the power circuit, I want him at the same time at least to consider the effect on the communication end of the game, because those mutual relations are what we have been trying to consider for the last year and a half.

R. W. Gray: Mr. Smith asked if there was any member of the Inductive Interference Committee present who could tell him whether or not they had taken into consideration static effects. I think that is very fully explained in the report. There is a great deal of data in the effects of electrostatic induction. I think there is a misconception in Mr. Smith's mind, due to the fact that telegraphers always refer to anything that causes trouble on a telegraphic circuit as static. What Mr. Smith referred to as a bat in the ear is what a telegrapher would call a static kick; and regarding the simple device that took the kick off the line, it is a fact well known, because if you hang enough capacity on the alternating circuit it will take all the juice off the line.

[To be continued.]

Electrical detection of icebergs by means of a submarine telephone recording the submarine echoes from the submerged portion of a large iceberg, of the sound waves sent out by striking a ship's bell lowered under water, is being investigated by the U. S. Bureau of Standards. Past experiments have been sufficiently promising to warrant further trial. With regard to recording temperatures in the vicinity of icebergs by means of an electric resistance thermometer, the general conclusions were that the temperature variations in parts of the ocean far removed from the ice are often as great and as sudden as in the immediate neighborhood of icebergs, and that it is not possible to draw positive conclusions as to the absence or proximity of ice from the temperature records of sea water.

JOURNAL OF ELECTRICITY
POWER AND GAS

FOUNDED 1887

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Crossley Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBT. SIBLEY, Treas. and Special Contributor
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

ON LIBRARY CARS OF ALL SOUTHERN PACIFIC TRAINS

TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	" "	3.50
Other Foreign Countries within the Postal Union	" "	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS.

Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

CONTENTS

The Best Control of Public Utilities 57

A Public Utilities Commission for Utah 60

Fusible Boiler Plugs 60

Industrial Uses of Fuel Oil 61
By F. B. Dunn.

The Cost of Electric Power 62

Inside Wiring Methods 63
By John Carrell.

Letter to the Editor on Arc Lamp Photometry 64

Inductive Interference Discussion 66

Electrical Detection of Icebergs 67

Editorial 68
Justifying Class Rates.
An Uudeveloped Power Market.
The "Jitney" Bus.

Personals 70

Meeting Notices 70

News of California Railroad Commission 71

News of Arizona Corporation Commission 72

Publications Received 72

New Catalogues 72

Books Received 72

Industrial 73
General Electric Transportation Exhibit.
Industrial Plant to Install Private Telephone System.

News Notes 74

Justifying Class Rates

The necessary difference in the rate charged for electric light and that charged for electric power is the cause of much dissatisfaction and misunderstanding among lighting consumers. Many people believe that they should enjoy the same rate for lighting their homes as is charged for running the motors in a brewery. This fundamental article of faith, or rather doubt, is so deeply rooted in their minds that no ordinary argument will convince them to the contrary. Doesn't the same wire and the same current go to the brewery as to the home; yet why should one pay two cents and the other ten cents a kilowatt-hour?

Oh kilowatt hour! how great has been the cost of thy name! Like Proteus of old, who had the power of assuming any shape he chose, you are always a kilowatt hour, no matter whether you are serving light, heat, cold or power. Little does the value of your service avail. Whatever is the cost of generating you, that, and that only, is the basis upon which we will buy you. Nor do we understand why you cost more when you are used just a few hours for lighting at night than when you are used all day for power.

Last week the suggestion was made in these columns that such complaints could have been obviated by differentiating between the names of the service for which current is sold, lighting being supplied in "lumen hours." But perhaps a better way than thus avoiding the issue is the argument by analogy adopted by Frank G. Baum in his paper on "The Best Control of Public Utilities," a part of which appears elsewhere in this issue. By avoiding such terms as diversity factor and load factor he greatly clears the issue.

People have become accustomed to different rates for passengers and freight on railways. They realize that it is just for a passenger to pay twenty times the ton-mile rate charged for freight and they understood that it is only by making freight rates low enough to to attract great traffic that it is possible to give a low passenger rate.

In the electrical industry lighting corresponds to the passenger business and power to the freight business. If half the total cost is due to supplying power (hauling freight) and half to lighting service (passengers) each of these classes should bring the same revenue. But if power consumers use five times as much current as lighting consumers it is evident that their unit rates should be in the ratio of one to five, i.e., if the power rate be one cent, the lighting rate would be five cents at the substation.

As a matter of engineering fact it costs far more to supply lighting consumers than power and furthermore the power consumers use much more of the total available energy. In addition the more power sold at a low rate the lower the proportion of the total cost which must be borne by the lighting consumer. If it were not for the fact that power (freight hauling) is low enough to attract large volumes of business, lighting (passenger) costs would be prohibitive. If it were not for the low grade business the rates for the high grade business would be greater. The fact that lighting rates are lower today than they were ten years ago is mainly due to the day power load which has been added.

The reasonableness of basing electric rates upon the class of service rendered is so manifest that it should be seriously considered by all rate-making bodies. This distinction has long been recognized in the case of the railroads and was recently adopted by the telegraph companies in their night-letter service so that there should be less difficulty in explaining the principles and the advantage of such rate classification.

An Undeveloped Power Market

In response to the efforts that have been made by the central stations to develop off-peak business and as a result of the curtailment of European electro-chemical imports since the war there is every evidence that the next five years will see the development of a number of great electro-chemical industries on the Pacific Coast. The power companies are offering attractive rates to industries which work while others sleep, raw materials are abundant and the market is ready.

The field of greatest immediate attraction is in the manufacture of the ferro-alloys which are used to alter the properties of steel. The electric furnace is better adapted to this purpose than the blast furnace employing carbon as a reducing agent because it gives a higher proportion of manganese, silicon, chronium, titanium, tungsten, vanadium or other element desired. It is also susceptible to more accurate temperature control and produces a more uniform product.

The electric smelting of iron ores has always been a fertile field for research and represents a tremendous investment in experimental work. In Norway it has been developed into a commercial industry largely on account of the low cost of power and the excellent grade of iron ore, both available at tide-water. A good grade of pig iron has been produced at Heroult, but the manufacture of ferro-alloys has proven more profitable. The difficulty of getting a suitable form of carbon as a reducing agent has retarded the development on the Pacific Coast where coke is scarce and charcoal too expensive. Crude oil is not a satisfactory carbon source, though promising experiments have been made with fixed gases produced from it. The suggestion is here made that the carbon briquettes which are now made as a by-product in the manufacture of oil-gas would prove satisfactory for the purpose. The lamp-black from gas works has long been a drug on the market, though it is 97 per cent pure carbon.

Another promising field is in the manufacture of air nitrates for fertilizer. The supply of Chili saltpeter is being rapidly exhausted and the nitrogen famine predicted by Crookes some years ago would now be a reality if it were not for the fixation of atmospheric nitrogen. This has been successfully accomplished by several inventors and is now a flourishing industry to several parts of the world.

There is little choice between the several processes which have been devised for this purpose, as they all give about the same efficiency when measured by the unit weight of nitric acid produced. It has been found in practice that about one-seventh of a pound of nitric acid is formed per kilowatt-hour of electrical energy, a theoretical efficiency of about four per cent. Great success has attended the use of high frequency current for this purpose and there is great likelihood that a small apparatus will soon be perfected so that every farmer can make his own nitrates on the ground.

Many other developments of the electric furnace for metallurgical work are a possibility of the near future. On account of the high load factor these industries are desirable from a central station standpoint. The conclusion to be drawn is that the undeveloped market for electric power is almost as large as the undeveloped power which will be unavailable when governmental restrictions are removed.

The "Jitney" Bus

The competition of the "jitney bus," to which reference has previously been made in these columns, is seriously affecting street railway earnings in all Pacific Coast cities. If this were fair competition on even terms the street railway men would have but little to say, but its unfairness is so manifest that they are seeking to have the traffic properly regulated.

In the first place the nickel-buses take only the cream of the traffic, the short, haul, while the street railways are obliged to carry passengers to suburban terminals for the same fare. The street cars give transfers, maintain a regular schedule during the most inclement weather and offer a dependable service. The buses do not.

Furthermore, the street railways must have franchises, their taxes are an important element in the municipal revenue, they are held responsible for all accidents to life and limb, and are required to maintain their right-of-way. The bus escapes all these burdens. Both are common carriers, and if it is just for one to come under the jurisdiction of a public utility commission it is certainly right that the other should be regulated likewise.

Little has been done as yet to regulate this mushroom growth. It is characteristic of the law to lag a half cycle or more behind economic progress. The municipalities have been waiting for the state commissions to assert their authority and the commissions will not interfere until local regulation has been tried out and failed.

In San Francisco the Exposition authorities welcome this adjunct to the means for handling the crowds which will visit the grounds, though the buses have been barred at the San Diego fair. At Los Angeles, where the "jitney" originated on the coast, the number of buses are increasing at an alarming rate. Berkeley refuses to allow competition along a street where an electric railway is operating under franchise. Seattle is expected to forbid their use along park drives and boulevards.

The ultimate answer to the question is an economic one. If the bus drivers are compelled to carry accident insurance bonds and to pay a gross revenue tax the competition would then be on a more equal basis. The buses give to street railways a valid argument for changing zone fares, should they so desire. The obligation to serve unprofitable territory along franchise routes calls for protection against unfair competition in the short haul, level ground districts. Time alone will work out the solution.

PERSONALS

A. M. Hunt, consulting engineer at San Francisco, is making a brief trip East.

H. L. Bleeker, of the Washington Water Power Company, was a visitor at Seattle recently.

C. V. Schneider, electrical contractor of Sacramento, was a visitor at San Francisco during the week.

H. R. Noack, president of Pierson, Roeding & Co., San Francisco, is on a trip through Northern California.

R. L. Frickey, engineer of the Northern California Power Company, Redding, California, was a recent visitor at San Francisco.

Chas. Northcutt, district engineer of the Sierra & San Francisco Power Company, Modesto, recently spent a few days at San Francisco.

Guy W. Talbot, president of the Pacific Power & Light Company, Portland, was a recent visitor to Seattle on business.

H. V. Greene, auditor for H. W. Johns-Manville Company, Chicago, at present at San Francisco, is making a business trip of the Pacific Coast.

J. E. Werlein, special agent for the Portland Railway, Light & Power Company, has been appointed statesman of the Jovian Order at Portland.

O. L. Coward, of the power and mining department of the Seattle office of the General Electric Company, is at San Francisco on company business.

J. H. Kelly, assistant treasurer of the Seattle branch of the Western Electric Company, has returned from the Western Electric Credit Men's Conference at Chicago.

L. F. Davidson, formerly with the Pacific Light & Power Company, Los Angeles, resigned to become associated with the firm of Holabird, Reynolds & Co., San Francisco.

W. C. Cheney has begun the construction and installation of an electric light and power plant in the town of Coupeville, Washington, the cost of the plant approximating $3000.

P. S. Benjamin, for some time associated with the United States Steel Products Company, San Francisco, has become associated with the Holabird-Reynolds Company, San Francisco.

W. N. Winter, formerly general superintendent of the Oregon-Washington Telephone Company at Hood River, Oregon, has acquired the controlling interest of the company and has been elected president.

J. W. White has resigned as salesman with the San Francisco office of the General Electric Company to devote his entire attention to the work of the Industrial Equipment Company, specialty manufacturers, at San Francisco.

E. L. Cox, head illuminating designer of the electrical department of H. W. Johns-Manville Company, with offices in New York City, is at Seattle to assist the Pacific Coast branches in carrying out several large installations.

R. L. Eltringham, state industrial accident commissioner of California, who has been making an inspection trip of the power lines in Sacramento Valley, Cal., returned to San Francisco during the week, after an absence of two weeks.

D. E. White, of the railway lighting department of the Seattle branch of the Westinghouse Electric & Manufacturing Company, has returned from an extensive trip throughout Eastern Washington. While at Pullman, Wash., he delivered a lecture before the students of Washington Agricultural College on "Student Courses in the Manufacturing Companies."

E. C. Heintze, electrical rate clerk, City Lighting Department, Seattle, Wash; **H. L. Talbot,** chief operator, P. E. & E. Ry., substations, Oswego, Ore., and **August Westerwick,** electrical repairman, Southern California Edison Co., Los Angeles, Cal., have been elected associate members of the American Institute of Electrical Engineers.

L. A. Hoff, general sales manager of H. W. Johns-Manville Company, Chicago, recently arrived at San Francisco, where he expects to stop for about ten days, during which time it is intended to hold a general sales conference of all the company's Pacific Coast representatives. Mr. Hoff speaks most optimistically of the business outlook for 1915.

Ford W. Harris of Los Angeles has given up his practice as a consulting engineer to enter the firm of Townsend, Graham & Harris, specializing in patent and trade-mark litigation. The new firm intends to make a specialty of electrical and mechanical cases. Frank L. A. Graham and F. M. Townsend, the other members of the firm, have been in business as patent attorneys in Los Angeles for some years.

Charles L. Benjamin, for the past eight years advertising manager for the Cutler-Hammer Manufacturing Co., Milwaukee, has acquired an interest in the Klau-Van Pietersom-Dunlap, Inc., advertising agency at Milwaukee, and will take an active part in the work of the organization. Mr. Benjamin is one of the foremost authorities on technical and trade paper advertising. He was the first editor of "Printers Ink" when it was founded in 1888, and since that time has had a rich and varied experience in all branches of publicity work. He is past president of the Advertisers' Club of Milwaukee and prominent in the affairs of all technical advertising organizations.

MEETING NOTICES.

Electrical Development and Jovian League.

The regular weekly meeting was held Wednesday of last week at a downtown cafe. Despite very wet weather, the attendance almost reached the hundred mark. Mr. C. F. Butte of the Butte Electrical Engineering and Construction Company, was chairman of the day and introduced his musical talent immediately after the conclusion of the regular league business. Promptly at one p. m. the speaker of the day, Mr. J. J. Dwyer, President of the State Harbor Commission, was introduced and gave a thirty-minute talk on the harbor work under completion and contemplated for San Francisco Bay in the effort to provide adequate shipping, dockage and transfer facilities at that port necessary to accommodate the increased shipping requirements incident to the opening of the Panama Canal. A unanimous vote of thanks was tendered the speaker and upon conclusion the meeting adjourned at 1:30 p. m.

The Jovian Electrical League of Southern California.

The weekly luncheon of the League, held at Christopher's, Los Angeles, on Wednesday, January 13th, was attended by about 125 Jovians and their friends. A splendid program was prepared by W. F. Westbrook, the chairman of the day. After the customary introduction of guests, Tribune Pieper announced the degree team appointments for the coming rejuvenation, which will take place at Hamburger's banquet halls and promises to be a record breaker, judging from the extent of the preparations which are being made. James Rogan was appointed chairman of the program committee in place of G. B. McLean, who resigned. Carl Johnson gave a snappy three-minute talk on C. H. Carter, whose father was present to hear the "eulogistic roast." Miss Laurie Ordway gave a comical recital entitled "The Militant Suffragette," and the officially adopted pianist, Dick Alter, entertained with several selections. He was followed by the speaker of the day, E. Ry., substations, Oswego, Ore., and **August Westerwick,** chosen to speak on "Style All the While." He dwelt on the

responsibility which rests on the shoulders of all California business men during 1915, while entertaining the immense crowds—estimated at two and a half millions—brought here through the expositions and conventions. He urged his hearers to foster sincere friendships among each other, to try and say only kind things of each other for just thirty days—and then keep it up—for, as he aptly put it, you can't move a vehicle along without moving along with it. Above all things, he said, tell the truth about California, for surely, with all the blessings which we enjoy, the truth is plenty good and big enough.

Oregon Irrigation Congress.

The fourth annual convention of the Oregon Irrigation Congress was held at Portland, January 7-9, 1915. The principal business transacted was embodied in a number of resolutions regarding needed legislation, both state and national. The most important were as follows:

Legislation is urged to levy one-half mill tax on all property in state for irrigation development.

Constitutional amendment giving state authority to issue bond for irrigation development is recommended.

Legislature asked to memoralize Congress, urging law permitting all natural Federal resources within the state to be used for sole purpose of raising funds to co-operate on dollar-for-dollar basis with the state in developing these resources.

Federal government urged to give Oregon its just share of reclamation fund and to guarantee bonds of accredited irrigation districts.

Repeal of law tax on water power filings urged.

Law recommended giving irrigation districts right to sell surplus water power.

Asa B. Thompson of Echo Oregon was re-elected president and F. M. Wallace of Laidlaw, secretary.

Western Red Cedar Association.

The ninth annual meeting of the Western Red Cedar Association was called to order January 11, 1915, at Spokane, by President Flannery. Representatives of the following companies were present:

B. J. Carney & Co.	Northern Mercantile Co.
E. T. Chapin Co.	Sandpoint Lumber & Pole Co.
Humbird Lumber Co.	The Valentine-Clark Co.
Lindsley Brothers Co.	Western Lumber & Pole Co.
Lost Creek Cedar Co.	American Lumberman.
National Pole Co.	

President Flannery reported among other matters that the National Electric Light Association had included specifications on Western red cedar poles in their new handbook.

"During the entire year, posts moved quite freely at fair prices, but at no time during the year was there a brisk demand for poles or piling. Consequently, we have been compelled to move these commodities at very low prices. The stocks on hand during the entire year have been very large in proportion to the amount of consumption. It is also to be noted here, that the volume of business was small in comparison to former years, owing to the unsettled conditions at home and abroad. We have carried over stocks, which, coupled with the poles that of necessity must be produced and manufactured, do not warrant forced production."

W. M. Leavitt, manager of the Spokane office of the National Pole Company, was elected President; E. T. Chapin of Spokane, vice-president, and G. C. McDonald, manager of the Spokane office of the Western Lumber Pole Company, H. C. Culver, president of the Sandpoint Lumber and Pole Company, and W. M. Burns, secretary of the Northern Mercantile Company, were elected directors.

R. L. Bayne was appointed Secretary-Treasurer.

E. M. Fronk, traffic manager of the Western Pine Manufactuers' Association, spoke to the Association regarding the new rate book just issued by his department and the other services connected with the traffic department.

Mr. C. P. Lindsley spoke on the "Future of the Cedar Pole Industry." Mr. Lindsley cited the case of the great saving effected by the electrification of the Butte, Anaconda & Pacific Railway, which in one year's operation had effected a saving of over 20 per cent in operating costs alone, and a total saving of over 36 per cent. The Chicago, Milwaukee & St. Paul Railway expect to make a similar saving by the electrification of their mountain divisions. Mr. Lindsley claimed that if a saving of this sort could be made, it would be but a question of time until the other steam roads adopted the electricity for motive power. As no pole has been discovered which can take the place of cedar, he claimed the Western red cedar industry still had a big future. Mr. Lindsley also insisted that to secure the benefits of this, it would be necessary for all the dealers to co-operate to urge the use of the Western red cedar pole and to work for the industry as a whole, rather than for individual advantage.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Pacific Gas & Electric Company has filed an application with the commission requesting authority to issue $4,000,000 of 5 per cent one-year gold notes to be dated December 15, 1914, and to be used in refunding $4,000,000 of its 5 per cent one year gold notes dated March 25, 1914. The company proposes to issue these notes at not less than 98 and to pledge as security for their payment $5,000,000 of its convertible general lien bonds and $5,000,000 of its general and refunding mortgage gold bonds.

The commission has issued a supplemental order authorizing the San Joaquin Light & Power Corporation to issue $150,000 of its Series B first and refunding mortgage 40 year 5 per cent bonds. These bonds are secured by deed of trust to The Trust Company of America. The time within which the company may issue these bonds is limited to June 30, 1915.

The Pacific Gas & Electric Company has filed a supplemental application with the railroad commission requesting authority to sell its general and refunding mortgage gold bonds at not less than 85. The commission on July 1, 1914, authorized the company to issue $5,000,000 of these bonds on the condition that it should later secure from the commission a supplemental order specifying the minimum price at which they were to be sold. At the same time, the company was authorized to issue $12,500,000 par value of first preferred stock.

The Tulare County Power Company of Lindsay, Tulare County, has filed an application with the commission requesting authority to renew notes in the sum of $200,000 held by C. J. Wrightman. The company also asks for authority to execute a note in the sum of $100,000 to be secured by a deed of trust and chattel mortgage covering all of its property. This mortgage will be inferior to the deed of trust held by C. J. Wrightman.

The Coast Counties Gas & Electric Company has filed an application with the commission requesting authority to renew a note in the sum of $15,000 held by the Bank of California National Association, falling due January 24, 1915.

The commission has replied to the letter of Mr. Jesse W. Lilienthal, president of the United Railroads, in regard to his proposal that further funds of the United Railroads be invested in the Solano Farms project. The commission takes the stand that the revenues of the United Railroads should be conserved for the purchase of new cars, for the improvement and extension of its service within the City of San Francisco, and for the payment of its obligations.

The Humboldt Transit Company, operating a street railroad in the City of Eureka, Humboldt County, has filed an application with the commission requesting authority to pledge eighteen of its first mortgage 5 per cent 30-year gold bonds

to the Pacific Coast Casualty Company. On December 9, 1914, the courts awarded Valentine Grossetti $7000 damages against the railroad company. The railroad company now proposes to appeal the case to the Supreme Court, and in order to do this it is necessary for it to give surety in double the amount named in the judgment.

The Oakland, Antioch & Eastern Railway has filed an application with the commission requesting approval of two notes in the sum of $58,000. These notes are dated January 29, 1913, and January 14, 1913, and run for a period of three years.

The commission has issued a supplemental order authorizing the Western Gas & Electric Company to issue $93,500 of its first and refunding 5 per cent bonds. These bonds are part of an issue of $219,000 previously passed upon by the commission. The present order was made necessary by reason of the fact that the time for issuance specified in the original order had expired.

The commission has issued a supplemental order relative to the issue of $150,000 of first and refunding mortgage bonds by the San Joaquin Light & Power Corporation. In its order just issued, the commission states that the authority to issue these securities shall apply to bonds numbered as follows: Bond No. 4383 and Bonds Nos. 4394 to 4542, inclusive.

The Marin County Electric Railways has filed a supplemental application with the commission requesting authority to commence construction work upon its Cascade branch, in accordance with an offer of the Hicks-Folte Corporation to accept in payment stock, notes of stock purchasers and installment stock subscriptions.

The commission has issued a notice that it will institute an investigation on its own initiative into the value of the property of the San Francisco-Oakland Terminal Railways. A public hearing has been set for Tuesday, February 23, before Commissioner Thelen at San Francisco.

The commission has issued a notice that it will conduct an investigation on its own initiative into the value of the property of the San Diego Electric Railway Company. A public hearing in the matter will be held at San Diego on Saturday, February 20, before Commissioner Thelen.

The commission has rendered a decision granting authority to the Mt. Whitney Power & Electric Company to issue $418,000 of preferred stock. The proceeds are to be used for the purpose of paying off the company's floating indebtedness. The issue is a 7 per cent cumulative preferred stock.

NEWS OF ARIZONA CORPORATION COMMISSION.

The commission has authorized the Globe Light & Power Company to construct and lay 2000 ft. of 4 in. gas main from its plant in the city of Globe to East Globe.

The commission has exempted the Ray Consolidated Copper Company from filing the uniform classification of accounts for electrical companies as this company is not supplying energy to the public.

The commission has ordered that F. J. Wharton's complaint against the Tucson Gas, Electric Light & Power Company for incorrect meter reading be dismissed.

PUBLICATIONS RECEIVED.

Bulletin 77 from the U. S. Bureau of Mines, "The Electric Furnace in Metallurgical Work," by Dorsey A. Lyon, Robert M. Keeney and Joseph F. Cullen is the latest and best treatise on this subject which has yet been published. The treatment is divided into three parts. The first treats of the design, construction and operation of electric furnaces in general; the second gives a brief statement of its application to smelting metals, aluminum, iron, lead, zinc and tin; and the third is concerned with the manufacture of ferro-alloys. Illustrations and details are given of the design and operation of all types of furnaces.

NEW CATALOGUES.

Century Electric Company are distributing an attractive folder entitled "It takes more than dirt to stop a Century" and illustrating Century motors successfully operating in dirty surroundings.

Westinghouse Electric & Manufacturing Company has issued an attractive folder describing the advantages of their small motors, giving strong arguments why central stations and dealers should handle them.

"Steel Transmission Line Structures and Catenary Bridges" is the subject of a well illustrated booklet from Archbold-Brady Company, Syracuse, N. Y. Views are shown and details given of towers and trolley bridges in many localities.

Bulletin No. 8 from The Pelton Water Wheel Company illustrates and describes standard Pelton wheels particularly adopted to driving mining, sawmill, industrial and the other machinery. Valuable hydraulic information and water wheel tables are included.

The Westinghouse Electric & Manufacturing Company has just issued Leaflet No. 3749, covering Westinghouse Synchronous Booster Rotary Converters, in which this type of apparatus is fully described and illustrated. "Westinghouse Electric Motors for Machine Tool Service" is the title of comprehensive pamphlet, with an art cover, describing the electrification of a machine shop, going into some detail as to the type of motor to be selected for each machine, and a recital of the characteristics of direct and alternating current motors as applied to this work. "Central Station Power in Coal Mines" is the title of pamphlet No. 3078. This pamphlet deals with the subject of electric power for coal mines and shows the advantages to be gained by the operator from using power from central station plants. A number of tables are given showing the cost of operation; curves are also given showing the day and night load in the mine. "Helping the Woodworker" is the title of an attractive pamphlet which gives in conversational form arguments for the use of motor drive for wood-working plants. Following the familiar series of "Joe and the General Manager" ads on railway apparatus, use is made of the manager of the wood-working plant and a Westinghouse salesman. During their conversation many points are brought out which are of interest to the operator of a wood-working plant.

BOOKS RECEIVED.

"Applied Electro-Chemistry and Welding," by Chas. F. Burgess and Geo. E. Cravens; 215 pp.; 5½x8½ in. Published by American Technical Society, Chicago, and for sale by Technical Book Shop, San Francisco. Price $1.50.

This book constitutes two separate treatises on the two subjects indicated by the title. The first section gives a concise summary of the principles of electrochemistry and their industrial application. The text is not technical nor does it give sufficient detail for the application of any of the processes illustrated. It is useful in giving a general up-to-date survey of the field. The second section gives illustrations and descriptions of the various methods of electric welding with sufficient information to enable any one interested to work out successful applications of the process.

"Automatic Telephony," by Arthur B. Smith and W. L. Campbell; 407 pp.; 6 by 9 in.; 271 illustrations. Published by McGraw-Hill Book Company, New York, and for sale by Technical Book Shop, Crossley Building, San Francisco. Price, $4.00.

This manual presents a complete account of the theory and practice of the automatic and semi-automatic telephone. Descriptions are given of the typical circuits and apparatus of each of the more important makes of equipment and special attention paid to the operating routine with the system made by the Automatic Electric Company. The book is indispensible to any telephone engineer who wishes to keep abreast with recent progress in the development of the art.

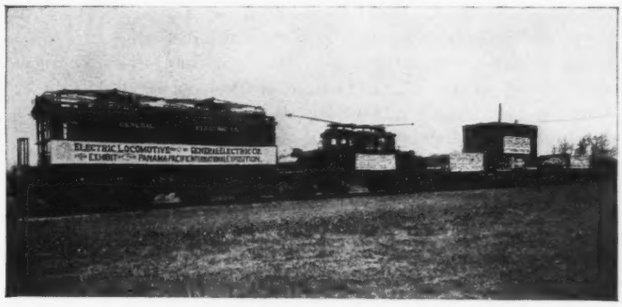
INDUSTRIAL

GENERAL ELECTRIC TRANSPORTATION EXHIBIT.

The exhibit of the General Electric Company in the Transportation Building at the Panama-Pacific International Exposition will comprise electric locomotives for various classes of service, including steam railroad electrification, railway motors and all kinds of apparatus and accessories for electric railways, signal accessory electric devices, electric apparatus and equipment for railway shops, electric illumination for cars and shops, etc.

One interesting exhibit will be the electric locomotives shown in the illustration coupled together ready for shipment across the continent. The Butte, Anaconda & Pacific locomotive is one of four units which have recently been built for this road and is a duplicate of the original seventeen units put into service in 1913. These are the first 2400-volt, direct-current electric locomotives ever built. Each unit weighs 80 tons.

A 60-ton electric locomotive of the type built for interurban freight and passenger service will be on exhibit. This machine is designed for both 600 and 1200 volt operation. The cab is of all-steel construction and is divided into three sec-



Electric Locomotives for P. P. I. E. Exhibit.

tions, the central operating cab containing the controller and other apparatus that should be within immediate reach of the engineer, and the two end steeple back cabs containing the auxiliary electrical apparatus. The motor equipment consists of four GE-251 commutating pole motors, one mounted on each axle. These motors are arranged for forced ventilation from a blower in the cab. The well-known type M multiple unit control is used and combined straight and automatic air brakes are provided. The trucks are the equalized type and conform to MCB standards.

There will also be a 16-ton electric locomotive of similar design with steeple-back end cabs for industrial freight and switching service. It is equipped with two commutating pole ventilated motors. Two types of mining electric locomotives will be shown. One is a large 20-ton trolley type equipped with three motors and the other is a 6-ton combination trolley and storage battery locomotive equipped with two motors, all of the commutating type.

A storage battery platform truck and also a battery truck crane for moving freight in warehouses, factories and on docks will be exhibited. There will be a portable air compressor set for use around factories, the compressor being fitted with a glass cover and the interior illuminated to show the operation. This same type CP-27 air compressor is employed with air brake systems, one of which will be displayed mounted on a rack the same as installed on a car, with all the valves and accessories for combined straight and automatic operation.

INDUSTRIAL PLANT TO INSTALL PRIVATE TELEPHONE SYSTEM.

The relation of the telephone to efficiency in the management of the industrial plant has become so well understood that there is an ever-increasing number of such plants using the telephone for expediting the carrying on of business routine. In recognition of this fact the J. I. Case Threshing Machine Company of Racine, Wisconsin, is preparing to put in operation an unusually complete private telephone system.

This company operates an exceedingly large plant in Racine, the principal buildings of which are about half a mile apart. In order to serve both parts of the organization in the most satisfactory manner, two complete switchboard equipments are to be installed. The switchboards, which will be of the Western Electric No. 1261 central battery private exchange type, will each have an initial equipment of 80 lines with capacity for additional lines to take care of future growth. Complete power plant, ringing, terminal and protective equipment will be used in connection with each switchboard.

The two private exchanges will be connected by means of trunk lines running in lead-covered cable. They will not, however, be connected to the city telephone service, as the lines are to be used exclusively for internal business communications. Certain officials of the organization will, of course, require service outside of the plant, and for this purpose a separate private branch exchange switchboard will be operated in connection with the local telephone company's lines.

Lead-covered cable will be used for the main distributing lines and twisted pair telephone wire for the wiring from the distributing points to telephone instruments. Three thousand feet of 25 pair and 12,300 feet of 50 pair cable will be installed. There will be outside distributing points on the grounds, at which cable terminals will be located. Loud ringing bells will be placed at various points inside and outside of buildings to call officials to the nearest telephone. These bells can also be used to sound alarms.

All telephone and construction material will be supplied by the Western Electric Company.

TRADE NOTES.

The Illinois Electric Company of Los Angeles is increasing its floor space, taking in the store next door to them, and hereafter its street address will be 261-263 So. Los Angeles street.

The Perkins Electric Company, Seattle, Wash., has just completed the installation of a storage battery lighting plant on the ranch of John McNeil, at Woodland, Wash. Water power is used for generating the current.

The General Electric Company has just closed a contract with the Washington Iron Works, Seattle, Wash., for 1000 h.p. of variable speed, resistance type, 3-phase, 60-cycle, 2200-volt induction motors. These motors are to be placed in the "Inter County Dredge," which is being built at the iron works. One motor will be 800 h.p., to drive a suction pump.

Effective January 1, 1915, the Westinghouse Electric & Manufacturing Company has provided for its employes a plan for sickness and accident relief, accident compensation and service pensions. The relief department administers a fund maintained by dues from its member employes and used in paying sick or death benefits, any deficiency being guaranteed by the company. The company also wholly supports an accident compensation fund for the benefit of all employes and furthermore allows a life pension for 70 year old employes who have been in the company service for 20 years.

NEWS NOTES

ILLUMINATION.

FAIRVIEW, MONT.—C. W. Jenison, of the local light, and power company has petitioned for a 30 year franchise for light and power.

HEALDSBURG, CAL.—The street lighting system is to be extended and improved in accordance with the action taken by the board.

KAMIAH, IDAHO.—A move is on foot by the Rawson-Works Lumber Company to install an electric lighting system, power to be furnished from their planing mill plant.

ANAHEIM, CAL.—The board of supervisors has granted Ferdinand R. Bain and his assigns the right to maintain a system of gas pipes in certain highways of Orange county.

SUSANVILLE, CAL.—The trustees have passed a resolution to grant H. Howard Dunbar a franchise for a gas plant and have ordered a notice of sale of the franchise published.

SAN LUIS OBISPO, CAL.—The Santa Maria Gas & Power Company has made application for a franchise to furnish artificial gas for light, heat, fuel, etc., in this city. Bids will be received up to February 8th.

SILVERTON, ORE.—The Portland Railway, Light & Power Company has served notice on the city of Silverton that it is ready to enter into negotiations in regard to installing a more adequate system of lights in the city.

LONG BEACH, CAL.—The board of public works has awarded a contract to the Woodhill & Hulse Electric Company to install an electric conduit and ornamental lighting posts along portions of First street and certain other streets, at $25,415.

KINGSBURG, CAL.—Eight blocks on Draper street are to be lighted with electroliers. Plans for the new system have been adopted and bids will be opened on January 25. The system will include 33 five-light electroliers. The cost is estimated at about $3500.

SAN DIEGO, CAL.—Although the city's contract with the San Diego Consolidated Gas & Electric Company to furnish current for arc light system of lighting city streets does not expire until June 1, Superintendent of Streets Adams has been granted permission by the council to advertise for bids for the contract renewal.

VICTORVILLE, CAL.—The board of supervisors has approved the assignment made by C. H. L. Ghreist and C. H. L. Ghreist Jr., to the Southern Sierras Power Company of all properties and interests in a certain agreement made between them and the Victorville lighting district for the construction of a lighting system and furnishing of lights to the district for 5 years.

EUGENE, ORE.—The semi-annual report of the Eugene water board, marking the close of three years' experiment with municipal electrical and water utilities, showed profits of $15,187 in six months on the electrical business, or more than 100 per cent above the total costs of operation and interest on bonds. The report showed profits of $8431 in six months' operation of the water plant, or more than 50 per cent of the total cost of operation. Of the total $54,638 revenues during the half year, the water and light board paid but $31,351 for operation and expenses. And of the total surplus of $23,351 it expended $9972 for improvements, leaving a net surplus of $13,547.

TRANSMISSION.

VENTURA, CAL.—The Pacific Light & Power Corporation has applied for a forty year franchise in Ventura county. Bids will be received up to February 6th for the sale of the franchise.

REDDING, CAL.—Frederick McArthur has applied for a franchise to transmit electricity in Shasta county. Bids will be received up to February 8th for the franchise.

NEWCASTLE, CAL.—A new power line three miles long is soon to be put in between Auburn and the Shirland Tract in Long Valley by the Bell Electric Company for furnishing power to farms in that vicinity.

TONOPAH, NEV.—The Nevada Valleys Power Company will begin service of supplying the Rochester District with electricity not later than February 1st. This line, which runs from Lahonton to Rochester, will cost approximately $200,000.

REDDING, CAL.—The California-Oregon Power Company has purchased a franchise from the board of supervisors of Trinity county and will commence to build power lines in the county early in the spring. The main line will go in by way of Castella.

REPUBLIC, WASH.—Applications for city and county power franchises have been prepared and will be presented to the board of county commissioners and the city council at an early date. These franchises will be asked for in the name of J. L. Harper as trustee for the Ferry County Power & Reduction Company.

BELLINGHAM, WASH.—Official announcement that the Stone & Webster interests will start construction of a power plant at Concrete, where the Baker River joins the Skagit is expected soon. Confirmation of the report that the corporation has closed a deal for 3000 acres of land along the Baker River has reached the local offices of the company.

AUBURN, CAL.—The Pacific Gas & Electric Company has agents in the field securing rights of way for the tower line between the No. 4 and No. 5 power houses, work on which was started before the construction work of 1913 was shut down. The tower line is to consist of 80 foot towers built of steel, resting on cement foundations.

TRANSPORTATION.

SAN FRANCISCO, CAL.—The public utility committee of the supervisors has agreed to recommend the passage of Vogelsang's ordinance, instructing the board of works to prepare plans and receive bids for the construction of the Church street Municipal Railway from Van Ness avenue and Market to a temporary terminus at Eighteenth street.

SAN FRANCISCO, CAL.—President Lilienthal of the United Railroads in his reply to the request of the board of supervisors for a declaration of its policy regarding extensions and other improvements to transportation facilities, states that no extensions to the system are to be expected. He points out that the company expended $250,000 last year in additions and betterments to the system over and above $600,000 maintenance charge. He says that he has 600 men at work, and promises to keep them busy reconstructing until after 1916, when he believes all the urgent work will have been completed.

TELEPHONE AND TELEGRAPH.

BATTLE MOUNTAIN, NEV.—The county commissioners of Lander have granted a franchise to the Bell Telephone Company of Nevada.

VISALIA, CAL.—The reorganization of the Farmersville Rural Telephone Company was affected recently and the line serving the Farmersville section will be rebuilt in places and the service improved .

FAIRVIEW, ORE.—The Fairview Mutual Telephone Company has rebuilt its line on Dayton road, putting in cedar poles and standard crossarms, pins and insulators, and new ground rods and batteries.

JOURNAL OF ELECTRICITY

POWER AND GAS

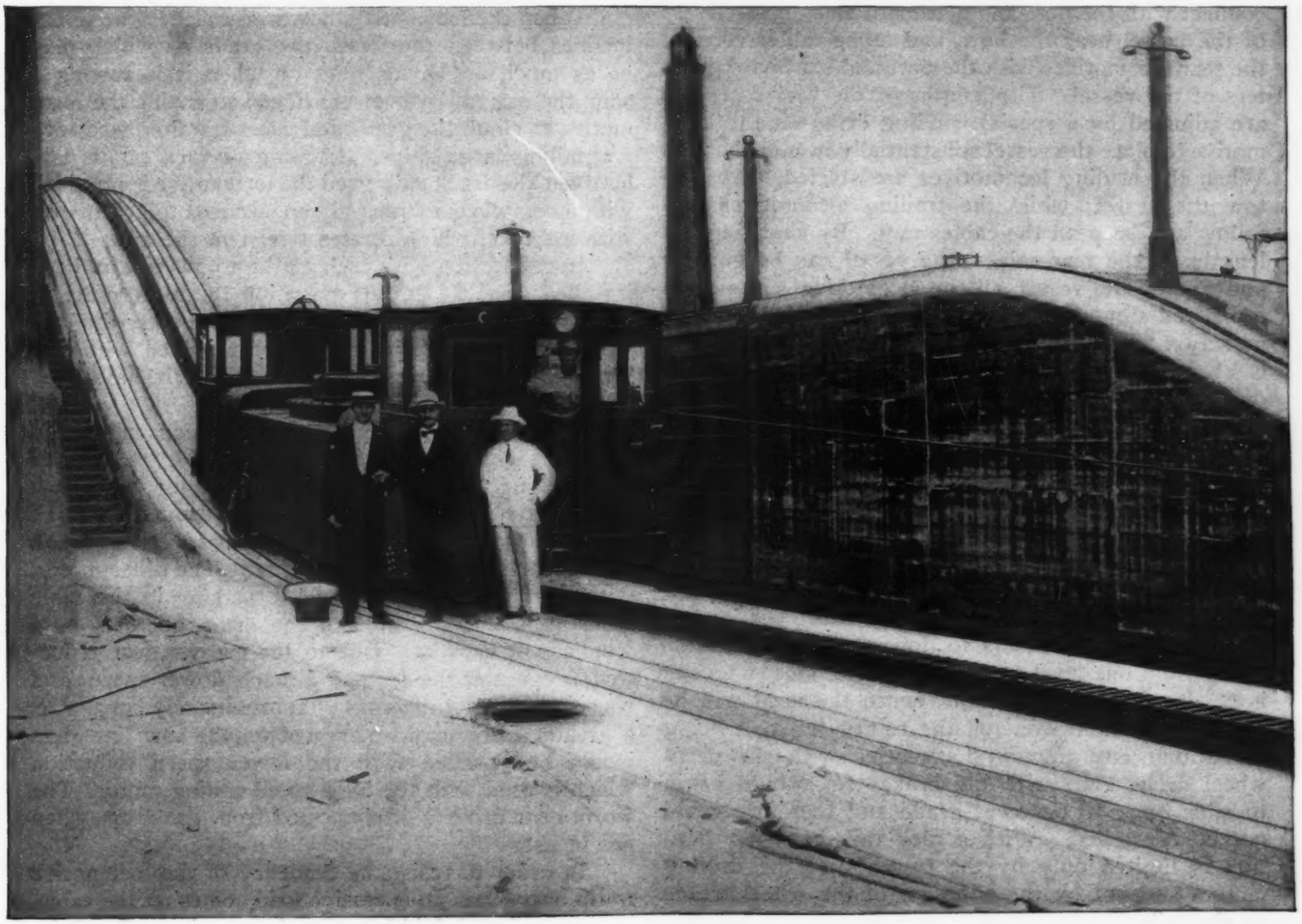
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXXIV SAN FRANCISCO, JANUARY 30, 1915 NUMBER 5

[COPYRIGHT 1915 BY TECHNICAL PUBLISHING COMPANY]

PANAMA CANAL ELECTRIC TOWING SYSTEM

In passing through the Canal from the Atlantic to the Pacific, a vessel will enter the approach channel in Limon Bay, which extends to Gatun, a distance of about 7 miles. At Gatun it will enter a series of three locks in flight and be raised 85 feet to the level of Gatun Lake. It may then steam at full speed through the channel in this lake, for a distance of 24 miles, to Bas Obispo, where it will enter the Culebra Cut. It will pass through this cut, which has a length of nine miles, and reach Pedro Miguel, where it will enter a lock and be lowered 30 ft. Then it will pass through Miraflores Lake for a distance of 1½ miles until it reaches Miraflores, where it will be lowered 55 feet through two locks, to the sea level, after which it passes out into the Pacific through an 8½ mile channel.



Towing Locomotive About to Ascend the Incline Leading to the Top Level of Gatun Locks. Standing in the Foreground, Left to Right, are: Edward Schildhauer, Electrician and Mechanical Engineer, Isthmian Canal Commission (I. C. C.); Lt. Col. William L. Sibert, Isthmian Canal Commissioner and Atlantic Division Engineer; C. W. Larson, Industrial Locomotive Designing Engineer, General Electric Company.

The main features of all the lock sites are identical; and the following brief description of the Gatun Locks, with special reference to the arrangement of the towing tracks, ship channels, inclines and ap-

NEWS NOTES

ILLUMINATION.

FAIRVIEW, MONT.—C. W. Jenison, of the local light, and power company has petitioned for a 30 year franchise for light and power.

HEALDSBURG, CAL.—The street lighting system is to be extended and improved in accordance with the action taken by the board.

KAMIAH, IDAHO.—A move is on foot by the Rawson-Works Lumber Company to install an electric lighting system, power to be furnished from their planing mill plant.

ANAHEIM, CAL.—The board of supervisors has granted Ferdinand R. Bain and his assigns the right to maintain a system of gas pipes in certain highways of Orange county.

SUSANVILLE, CAL.—The trustees have passed a resolution to grant H. Howard Dunbar a franchise for a gas plant and have ordered a notice of sale of the franchise published.

SAN LUIS OBISPO, CAL.—The Santa Maria Gas & Power Company has made application for a franchise to furnish artificial gas for light, heat, fuel, etc., in this city. Bids will be received up to February 8th.

SILVERTON, ORE.—The Portland Railway, Light & Power Company has served notice on the city of Silverton that it is ready to enter into negotiations in regard to installing a more adequate system of lights in the city.

LONG BEACH, CAL.—The board of public works has awarded a contract to the Woodhill & Hulse Electric Company to install an electric conduit and ornamental lighting posts along portions of First street and certain other streets, at $25,415.

KINGSBURG, CAL.—Eight blocks on Draper street are to be lighted with electroliers. Plans for the new system have been adopted and bids will be opened on January 25. The system will include 33 five-light electroliers. The cost is estimated at about $3500.

SAN DIEGO, CAL.—Although the city's contract with the San Diego Consolidated Gas & Electric Company to furnish current for arc light system of lighting city streets does not expire until June 1, Superintendent of Streets Adams has been granted permission by the council to advertise for bids for the contract renewal.

VICTORVILLE, CAL.—The board of supervisors has approved the assignment made by C. H. L. Ghreist and C. H. L. Ghreist Jr., to the Southern Sierras Power Company of all properties and interests in a certain agreement made between them and the Victorville lighting district for the construction of a lighting system and furnishing of lights to the district for 5 years.

EUGENE, ORE.—The semi-annual report of the Eugene water board, marking the close of three years' experiment with municipal electrical and water utilities, showed profits of $15,187 in six months on the electrical business, or more than 100 per cent above the total costs of operation and interest on bonds. The report showed profits of $8431 in six months' operation of the water plant, or more than 50 per cent of the total cost of operation. Of the total $54,638 revenues during the half year, the water and light board paid but $31,351 for operation and expenses. And of the total surplus of $23,351 it expended $9972 for improvements, leaving a net surplus of $13,547.

TRANSMISSION.

VENTURA, CAL.—The Pacific Light & Power Corporation has applied for a forty year franchise in Ventura county. Bids will be received up to February 6th for the sale of the franchise.

REDDING, CAL.—Frederick McArthur has applied for a franchise to transmit electricity in Shasta county. Bids will be received up to February 8th for the franchise.

NEWCASTLE, CAL.—A new power line three miles long is soon to be put in between Auburn and the Shirland Tract in Long Valley by the Bell Electric Company for furnishing power to farms in that vicinity.

TONOPAH, NEV.—The Nevada Valleys Power Company will begin service of supplying the Rochester District with electricity not later than February 1st. This line, which runs from Lahonton to Rochester, will cost approximately $200,000.

REDDING, CAL.—The California-Oregon Power Company has purchased a franchise from the board of supervisors of Trinity county and will commence to build power lines in the county early in the spring. The main line will go in by way of Castella.

REPUBLIC, WASH.—Applications for city and county power franchises have been prepared and will be presented to the board of county commissioners and the city council at an early date. These franchises will be asked for in the name of J. L. Harper as trustee for the Ferry County Power & Reduction Company.

BELLINGHAM, WASH.—Official announcement that the Stone & Webster interests will start construction of a power plant at Concrete, where the Baker River joins the Skagit is expected soon. Confirmation of the report that the corporation has closed a deal for 3000 acres of land along the Baker River has reached the local offices of the company.

AUBURN, CAL.—The Pacific Gas & Electric Company has agents in the field securing rights of way for the tower line between the No. 4 and No. 5 power houses, work on which was started before the construction work of 1913 was shut down. The tower line is to consist of 80 foot towers built of steel, resting on cement foundations.

TRANSPORTATION.

SAN FRANCISCO, CAL.—The public utility committee of the supervisors has agreed to recommend the passage of Vogelsang's ordinance, instructing the board of works to prepare plans and receive bids for the construction of the Church street Municipal Railway from Van Ness avenue and Market to a temporary terminus at Eighteenth street.

SAN FRANCISCO, CAL.—President Lilienthal of the United Railroads in his reply to the request of the board of supervisors for a declaration of its policy regarding extensions and other improvements to transportation facilities, states that no extensions to the system are to be expected. He points out that the company expended $250,000 last year in additions and betterments to the system over and above $600,000 maintenance charge. He says that he has 600 men at work, and promises to keep them busy reconstructing until after 1916, when he believes all the urgent work will have been completed.

TELEPHONE AND TELEGRAPH.

BATTLE MOUNTAIN, NEV.—The county commissioners of Lander have granted a franchise to the Bell Telephone Company of Nevada.

VISALIA, CAL.—The reorganization of the Farmersville Rural Telephone Company was affected recently and the line serving the Farmersville section will be rebuilt in places and the service improved .

FAIRVIEW, ORE.—The Fairview Mutual Telephone Company has rebuilt its line on Dayton road, putting in cedar poles and standard crossarms, pins and insulators, and new ground rods and batteries.